UNIVERSIDAD COMPLUTENSE DE MADRID

FACULTAD DE CIENCIAS BIOLÓGICAS

Departamento de Biología Vegetal I (Botánica y Fisiología Vegetal)

TESIS DOCTORAL

Taxonomía y sistemática de Stipa Sect. Stipa L. (POACEAE) y grupos afines

MEMORIA PARA OPTAR AL GRADO DE DOCTOR

PRESENTADA POR

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Madrid, 2013

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TAXONOMÍA Y SISTEMÁTICA DE STIPA SECT. STIPA L. (POACEAE) Y GRUPOS AFINES.

Memoria presentada para optar al título de Doctor en Biología por:

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Dr. Carlos Aedo **Dr. Miguel Ángel García**

MADRID

2012

A Gonzalo

AGRADECIMIENTOS

En primera instancia quiero dedicar mi Tesis Doctoral, al gran número de personas de mi entorno, que desafortunadamente no pueden estar conmigo. En primera instancia, a mi querida madre Natividad Estébanez Blanco, que siempre ha estado a mi lado y a la que la debo absolutamente todo y cuya ausencia he hecho más duro el tramo final de mi Tesis. Un especial recuerdo a mis fallecidas abuelas Adelina Blanco Casado y Julia García Silveiro que eran como unas madres para mí. A mis fallecidos tíos Javier Gonzalo García y Jesús Gonzalo García con los que compartí buenos momentos. Agradezco al fallecido Dr. Santiago Castroviejo, por concederme la oportunidad de trabajar para el proyecto *Flora iberica*, como editor adjunto, y en segunda instancia, por brindarme la oportunidad de hacer el doctorado en el Real Jardín Botánico de Madrid y permitir iniciar mi formación como investigador.

Cuando ya hace unos años atrás acabé la carrera de ciencias Biológicas, no sabía con certeza a que iba a dedicar mi vida, aunque por aquel entonces ya disfrutaba de la belleza del Jardín Botánico como guía ambiental, mi futuro todavía estaba en vilo. Sin embargo un buen día, una llamada inesperada proveniente de una antigua profesora de la Facultad de Biología, me abrió las puertas al centro de la investigación. Por ello en mi primera instancia agradezco a la Dra. Maruja Carrasco por acordarse de mí, para lo que sería a posteriori mi primer contacto con el mundo de la investigación. Agradezco a los doctores Carlos Aedo y Miguel Ángel García, por la dirección de los trabajos realizados, por haberme guiado con su experiencia, sus conocimientos transmitidos y su apoyo e interés continuo durante mi formación.

Agradecimientos a toda mi familia que me han apoyado desde el inicio, tanto en los momentos malos como en los momentos buenos y cuyos consejos, ayuda y su apoyo me han ayudado a seguir este camino. También debo agradecer a mi esposa Inés Redondo Salcedo a quien le debo absolutamente todo, y quien me ha acompañado desde la Facultad, aportándome unos de los momentos más felices e inolvidables de mi vida, el nacimiento de mi hijo Daniel Gonzalo Redondo, quien junto a mi mujer es soporte y motivación para los momentos duros del final de la Tesis.

Agradecimientos a todos mis compañeros del Jardín, que me han acompañado y apoyado durante mi estancia en el centro como fuera de él, haciendo los momentos difíciles algo más liviano. También quiero agradecer a la gente vinculado al proyecto de

Flora iberica, que me han acompañado desde el inicio y por los buenos momentos que he podido disfrutar durante los viajes de recolección. Asimismo agradezco a mis amigos no vinculados con mi mundo profesional, por los buenos momentos compartidos y hacer más llevaderos los momentos duros.

Finalmente quiero expresar mi agradecimiento al centro Real Jardín Botánico de Madrid, por poner a mi disposición su infraestructura. También me gustaría gradecer el trato recibido por el personal y las instituciones que me acogieron durante mis estancias, Universidad Politécnica de Huesca, Instituto Botánico Komarov de San Petersburgo, Universidad de Montpellier y al Museo de Ciencias Naturales de Viena a cargo del proyecto europeo Synthesys. A todos los herbario que amablemente han enviado material de herbario para sus estudio. A todos ellos gracias.

ÍNDICE

INTRODUCCIÓN

El género *Stipa* L. es un complicado grupo de gramíneas, cuya caracterización y límites taxonómicos siguen siendo fuente de controversia. Fue descrito por Linnaeus (1753), quien utilizó las palabras de origen griego “Stupe” o “Stuppeion” (plumosa o fibrosa) en referencia probablemente a la arista plumosa de algunas especies (*Stipa pennata* L.), cuya vistosidad hace que sean cultivadas como plantas ornamentales. También se baraja la hipótesis de que Linnaeus (1753) se refiriese a las hojas fibrosas de algunas de estas plantas (*S. tenacissima* L.).

Actualmente el género *Stipa* y afines se han agrupado en la tribu *Stipeae* Kunth (Clayton y Renvoize 1986; Hsiao y col. 1999) dentro de la subfamilia *Pooideae* (GPWG 2001; Soreng y col. 2007). La tribu *Stipeae* comprende aproximadamente 400–600 especies perennes o anuales distribuidas principalmente en zonas templadas y subtropicales de ambos hemisferios desde el nivel del mar hasta zonas de alta montaña de Sudamérica y de las cordilleras asiáticas (Bor 1970; Tzvelev 1976; Cope 1982; Freitag 1985; Moraldo 1986; Clayton y Renvoize 1986; Watson y Dallwitz 1992). La tribu se caracteriza por presentar una sola flor por espiguilla y sin raquilla, lema acabado en una arista terminal, flores con tres lodículas (raramente dos) y con cromosomas muy pequeños, cuyo número básico es x= 10–12 (Tzvelev 1976; Freitag 1985; Clayton y Renvoize 1986; Romaschenko y col. 2007, 2010).

El núcleo de las *Stipeae* (subtribu *Stipeae* s. str.) es considerado un grupo monofilético (Hsiao y col. 1999; Jacobs y col. 2000, 2007; Soreng y col. 2007). Por el momento la relación de las subtribus *Ampelodesminae* Connert y *Duthienae* Pilg. ex Potztal., con la tribu *Stipeae* no ha sido satisfactoriamente aclarada. El género *Ampelodesmus* J. Woods fue inicialmente incluido dentro de las *Stipeae* por Decker (1964) por la similitud anatómica de las hojas basales, a lo que hay que añadir la presencia de tres lodículas, cromosomas pequeños, ovarios pubescentes y hojas con las costilla bien marcadas (Barkworth y col. 2008). Algunos estudios filogenéticos también apoyan su inclusión en la tribu *Stipeae* o su estrecha relación con este grupo (Soreng y col. 1998; Hsiao y col. 1999; Jacobs y col. 2007; Soreng y col. 2007; Romaschenko y col. 2010). Sin embargo, difiere de los demás miembros de la tribu en la presencia de más de una flor por espiguilla y la presencia de raquilla (Barkworth y col. 2008), por lo que muchos autores proponen tratar el género en una tribu monoespecífica aparte: *Ampelodesmeae* (Conert) Tutin. (Watson y Dallwitz 1992; Barkworth y col. 2008). La ubicación de las *Duthienae* es más controvertida, ya que algunos autores dudan incluso de su inclusión en las *Pooideae* (Watson y Dallwitz 1992).

En la sistemática de las *Stipeae* la delimitación de los géneros, que ha cambiado sustancialmente en las recientes décadas, es el punto más conflictivo. En la segunda mitad del siglo XX se reconocían 300–400 especies distribuidas en 12–16 géneros (Watson y Dallwitz 1986; Clayton y Renvoize 1986; Tzvelev 1989). La tendencia actual, basada tanto en datos morfológicos como moleculares, es mucho más analítica. En estos momentos se reconocen 400–600 especies distribuidas en 23–28 géneros (Barkworth y col. 2008; Cialdella y col. 2010; Romaschenko y col. 2010). Lejos de estabilizarse, tanto el número de especies como los límites genéricos, están en constante evolución.

Los principales cambios en la sistemática de la tribu *Stipeae* son los que se refieren a los representantes americanos. Bentham y Hooker (1883) reconocieron solo dos géneros en la tribu, *Stipa* y *Oryzopsis* Michx. Hitchcock (1925, 1951) además de los dos géneros anteriores acepta para América los géneros *Piptochaetium* J. Presl y *Nassella* (Trin.) Desv. Spegazzini (1901, 1925) añade *Oryzopsis* y *Aciachne* Benth., y sobre la base de caracteres de la espiguilla, acepta doce subgéneros en el seno de *Stipa*. Son muchos los agrostólogos que en sus tratamientos taxonómicos han seguido la línea tradicional de estos autores (Clayton y Renvoize 1986; Nicora y Rúgolo de Agrasar 1987; Curto 1998; Renvoize 1998). Más recientemente se han descrito géneros como *Amelichloa* Arriaga y Barkworth o se han reconsiderado otros como *Jarava* Ruiz y Pavón. También se han aceptado en el rango genérico *Anatherostipa* (Kuntze) Penail., *Hesperostipa* (M.K. Elias) Barkworth y *Pappostipa* (Speg.) Romasch., P.M. Peterson y Soreng que se venían tratando como subgéneros.

Como consecuencia el género *Stipa* ha pasado de tener entorno 300–400 especies, distribuidas principalmente en zonas áridas y semiáridas de todos los continentes menos en la Antártida (Clayton y Renvoize 1986; Tzvelev 1976; Bor 1970; Cope 1982; Moraldo 1986; Freitag 1985; Watson y Dallwitz 1992), a estar representado por unas 120 especies distribuidas en Europa, Asia y el de Norte de África (Romaschenko y col. 2007; Barkworth y col. 2008). En este concepto restrictivo *Stipa* se caracteriza por tener una flor por espiguilla, con el anthecio adherido a la base de las glumas por un callo agudo, que deja una cicatriz al desprenderse. El lema es generalmente, largo, cilíndrico, coriáceo, convoluto y acabado en una arista central. La arista es unigeniculada o bigeniculada, y generalmente retorcida debajo del primer punto de torsión.

Dumortier (1823) fue el primer autor en hacer una clasificación infragenérica del género *Stipa* reconociendo dos secciones basadas en caracteres de la arista: *Eriostipa* Dumort. "*Arista plumosa vel pubescent*" que incluye *S. pennata* L., y *Leiostipa* Dumort para las especies de "*Arista glabra*", como *S. capillata* L. La falta de caracteres morfológicos exclusivos de cada grupo ha resultado en una clasificación infragenérica controvertida a pesar de los esfuerzos de Bor (1970), Tzvelev (1974, 1976), Martinovský (1977, 1982), Moraldo (1986), Vázquez y Devesa (1996), Vázquez y Gutiérrez (2011). Estos autores emplean principalmente los caracteres de la arista y el lema para sus clasificaciones. Freitag (1985) proporciona una nueva visión

fundamentada en caracteres del callo en combinación con caracteres de las glumas, arista y hábito. Martinovský (1966, 1967, 1970, 1976, 1977, 1980, y 1982), es el primer autor que proporciona una clasificación infragenérica de la sección *Stipa* s.str., y la basa principalmente en caracteres de las hojas basales.

El punto de partida para el presente estudio ha sido las contribuciones de Freitag (1985) por la solidez de los caracteres que emplea en su tratamiento. Para dicho autor la sect. *Stipa* comprendería unas 15 especies. Un análisis detallado de literatura reciente ha permitido reducir dicha cifra ya que autores como Tzvelev (1976), Martinovský (1982), Moraldo (1985) y Vázquez y Devesa (1996) transfieren algunas especies a otras secciones o géneros.

El trabajo que aquí presentamos se limita a las especies de la sect. *Stipa s. str.*, que se caracterizan por la arista bigeniculada, con la seta plumosa (pelos mayores de 3,5 mm), ovario con dos estilos y comprende 14 especies distribuidas por Europa, NW de África y Asia. A este grupo se ha añadido otras dos secciones: *Smirnovia* Tzvelev (13 especies distribuidas por Asia) caracterizado por tener la arista unigeniculada o bigeniculada, con la seta plumosa (pelos mayores de 3 mm), lígulas de las hojas basales cortas, ovario con dos estilos y *Subsmirnovia* Tzvelev (1 especie del W de Asia), caracterizado por tener la arista unigeniculada, con la seta plumosa, lígulas muy largas y ovario con dos estilos. Ambas secciones muestran una similitud morfológica con la sección *Stipa* y por lo que su estudio se hacía necesario para reforzar las conclusiones sobre dicha sección.

El objetivo principal es presentar una revisión taxonómica de las tres secciones, basadas principalmente en el estudio morfológico y anatómico de material de herbario procedente de toda el área de distribución. Se emplean en la medida de lo posible análisis morfométricos, univariantes y multivariantes para clarificar las relaciones taxonómicas de las especies y sus taxones infraespecíficos. Se ha estudiado el valor discriminatorio de los caracteres empleados tradicionalmente y se han buscado nuevos caracteres. De este modo se ha elaborado una propuesta taxonómica para las secciones *Smirnovia*, *Stipa* y *Submirnovia*, con nuevas claves dicotómicas, descripciones detalladas, sinonimia, tipificaciones, mapas de distribución e ilustraciones de cada taxon.

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Capítulo 1. Dos combinaciones nuevas en *Stipa* sección *Smirnovia* (Poaceae). Two new combinations in *Stipa* sect. *Smirnovia* (Poaceae)

Resumen

Fundamentado en observaciones morfológico y en consideraciones fitogeográficas, se proponen dos nuevas combinaciones para *Stipa* sección *Smirnovia* (Poaceae), un grupo de taxones distribuidos principalmente en Asia Central: *Stipa lingua* Junge subsp. *lipskyi* (Roshev.) R. Gonzalo comb. y stat. nov. y *Stipa lingua* subsp. *magnifica* (A. Junge) R. Gonzalo comb. y stat nov. *Stipa ovczinnikovii* Roshev. es reconocido como un sinónimo de *S. lingua*. Se presenta una clave para la identificación de las subespecies de *S. lingua*.

Ann. Bot. Fennici 48: 159–162 ISSN 0003-3847 (print) ISSN 1797-2442 (online)
Helsinki 29 April 2011

Two new combinations in *Stipa* sect. *Smirnovia* (Poaceae)

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Received 26 May 2009, revised version received 24 Feb. 2010, accepted 26 Feb. 2010

Gonzalo, R., Aedo, C. & García, M. Á. 2011: Two new combinations in *Stipa* sect. *Smirnovia* (Poaceae). — *Ann. Bot. Fennici* 48: 159–162.

Based on morphological observations and phytogeographical considerations, two new combinations are provided in *Stipa* section *Smirnovia* (Poaceae), a group of taxa mainly distributed in central Asia: *Stipa lingua* Junge subsp. *lipskyi* (Roshev.) R. Gonzalo *comb. & stat. nov.* and *Stipa lingua* subsp. *magnifica* (A. Junge) R. Gonzalo *comb. & stat. nov. Stipa ovczinnikovii* Roshev. is recognized as a taxonomic synonym of *S. lingua*. A key to the subspecies of *S. lingua* is provided.

Stipa section *Smirnovia* includes 13 species mainly ranging from Caucasus to western China and southern Siberia, reaching the highest diversity in central Asia. These species thrive from lowlands to high mountain ranges, occurring in subdeserts and steppes. The section is easily recognized by having a unigeniculate awn with a glabrous to pilose column, and a plumose seta (Tzvelev 1974).

Stipa lingua, *S. ovczinnikovii*, *S. lipskyi*, and *S. magnifica* constitute a very polymorphic group of taxa in the section *Smirnovia*. The group is characterized by a long, straight, and plumose seta, and a foot-like expanded callus (Tzvelev 1983). The distribution of these taxa ranges from northern Iran through Afghanistan, Turkmenistan, the Pamir, and the Altai to western Tian Shan range (Junge 1910, Pazij 1968, Tzvelev 1983, Freitag 1985). Other species that could be related to them due to their similar awn structure are *S. karataviensis*, *S. aktauensis*, and *S. longiplumosa*. *Stipa karataviensis* has a foot-like expanded callus, but it can be readily distinguished from *S. lingua* and its closest relatives by having three distinct rows of hairs along the lemma instead of seven rows, and much smaller spikelets. *Stipa aktauensis* also has smaller spikelets and lacks a foot-like expanded callus. Finally, *S. longiplumosa* is quite similar in size to the group of *S. lingua*, but it has a longer column and a glabrous lemma apex, whereas the members of the *S. lingua* group have a coronula.

After a careful examination of the morphology of the species in *Stipa* sect. *Smirnovia*, as well as a critical study of the diagnostic characters, we consider *S. magnifica* and *S. lipskyi* to be subspecies of *S. lingua*, and treat *S. ovczinnikovii* as a taxonomic synonym of *S. lingua* subsp. *lingua*.

Stipa lingua Junge subsp. ***lipskyi*** (Roshev.) R. Gonzalo, *comb. & stat. nov.*

Stipa lipskyi Roshev. *in* B. Fedtsch. (ed.), Fl. Aziat. Ross. 12: 153. 1916. — Type. Uzbekistan. Samarkand district, Samarkand, 27.V.1897 *Lipsky 4530* (lectotype LE!, designated by Tzvelev 1983; isolectotype MW, not seen).

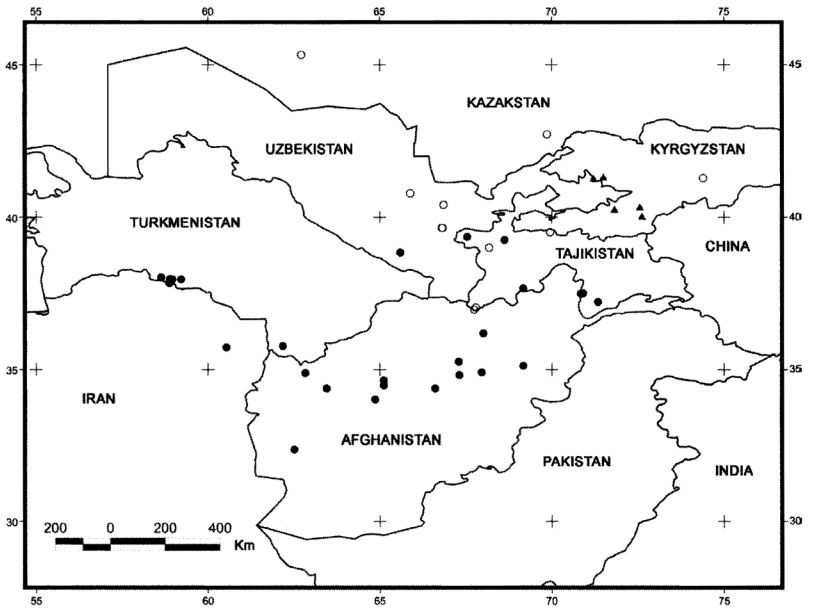

Fig. 1. Distribution map of *Stipa lingua* subsp. *lingua* (●), *S lingua* subsp. *lipskyi* (O) and *S. lingua* subsp. *magnifica* (▲).

Stipa lingua Junge subsp. ***magnifica*** (A. Junge) R. Gonzalo, *comb. & stat. nov.*

Stipa magnifica A. Junge, Izv. Imp. S.-Peterburgsk. Bot. Sada. 10: 128, tab. IV. 1910. — TYPE. Kyrgyzstan. Fergana province, Oš district, close to Gulcza, VI.1900 *Transchel s.n.* (holotype LE!; isotypes LE!, MW, not seen).

Stipa barbata Desf. var. *platyphylla* Hack. *in* Paulsen, Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 65: 163 (1903). — TYPE. Kyrgyzstan. Alai mountains, Sufi Kurgan., 18.VI.1898, *Paulsen 407* (C).

Stipa lingua subsp. *lipskyi* essentially differs from the other subspecies by having a glabrous column with small tubercles (invisible to the naked eye). It shares with subsp. *magnifica* a wholly villous callus, whereas in subsp. *lingua* it usually is almost glabrous. Despite of the general distinction between these two taxa, we have observed that some specimens of subsp. *lingua* from Afghanistan have a wholly villous callus. The resemblances in size and shape of the spikelet between these two taxa, was also noticed by Tzvelev (1983), who suggested to consider a subspecies status for *S. lipskyi,* in agreement with the combination here proposed. *Stipa lingua* subsp. *lipskyi* occurs from the Kyrgyzian steppes through the Kyzylkum desert and western Tian Shan range to western Tajikistan, whereas subsp. *lingua* is a more southern taxon, occurring from Turkmenistan mountains, through northern Iran and Afghanistan, to the southwestern Pamir. The distribution areas of the two subspecies only overlap in the southwestern Tajikistan (Fig. 1).

Stipa lingua subsp. *magnifica* has been separated from *S. lingua* on account of its larger florets and longer awns (23–28 *vs.* 15–20 cm), non-swollen upper cauline sheaths, free panicles from their sheath, and the wholly villous callus (Junge 1910, Roshevitz 1934, Pazij 1968, Tzvelev 1983). However, after a careful morphological revision of the collected material, we checked these morphological characters and found them to be highly variable. It was not possible to detect a clear difference in the size of the floret. Moreover, some specimens of subsp. *lingua* have awns ca. 24 cm long (e.g., *Michelson 234*, G!), and others, from Turkmenistan and Afghanistan, have non-swollen upper cauline leaf sheaths with free panicles and a wholly villous callus. This makes the diagnostic reliability of these characters doubtful. Only the absence of hairs below the culm nodes and the lengthy hairy branches of the panicle showed to be stable enough to distinguish the two subspecies (Table 1). *Stipa lingua* subsp. *magnifica* is a more eastern taxon than the other subspecies, occurring in the Alai mountains of Kyrgyzstan, from where no specimens of subsp. *lingua* have been collected (Fig. 1).

Stipa ovczinnikovii requires special attention. It was originally distinguished from *S. lingua* (Roshevitz 1934) by its shorter floret (12–13 *vs.* 14–16 mm) and the equal plumosity of the awn. Tzvelev (1984) retained its specific rank and suggested its possible hybrid origin between *S. lingua* and *S. longiplumosa*. However, Pazij (1968) and Freitag (1985) listed *S. ovczinnikovii* as a synonym of *S. lingua*. A careful examination of the plants studied supports the latter view, as most of the specimens of *S. lingua* have intermediate morphological features.

Key to the subspecies of *Stipa lingua*

1. Column scabrous or tuberculate ..... subsp. *lipskyi*
1. Column pilose 2
2. Panicle branches with hairs (0.2)0.3–0.4(1.3) mm long; culms below nodes pilose; lemma with hairs (1.1)1.3–1.6(2.2) mm long; callus dorsal surface usually glabrous; seta (13.9)16.7–19.7(24.4) cm long ..... subsp. *lingua*
2. Panicle branches with hairs 1–2.2(2.5) mm long; culms below nodes glabrous; lemma with hairs (0.7)1–1.1(1.3) mm long; callus dorsal surface villous; seta (19)21–22(26) cm long ..... subsp. *magnifica*

ADDITIONAL SPECIMENS EXAMINED: — ***Stipa lingua*** subsp. ***lingua***. **Afghanistan**. Prov. Samangan, *Podlech 31631* (G, M); Prov. Parwan, *Anders 10834* (G); Wardar, X.1952, *Volk 1281* (B); Prov. Parwan, *Podlech 12051* (K, M); Prov. Ghorat, *Rechinger 18898* (G, W); Hari-rud valley, *Aitchinson 1137* (G, K, UPS, WU); Elepasti, *Rodenburg 233* (L); Hari-rud valley, *Aitchinson 1137* (C, UPS); Prov. Herat, *Unger 117* (MSB); High part of Shibar pass, *Pabot 1110* (G). **Iran**. Prov. Khorasan, *Rechinger 1357* (S, W); Herat and Farah, *Gilli 413* (W). **Tajikistan**. West Pamir, low part of Šachdary river valley, southwest slope of Schugnan range, 13.VII.1964 *Grubov, Kurbambekov & Yunysov s.n.* (LE); Schugnan, *Tuturin & Bessedin 371* (LE); Zeravshan range in the plateau of high mountains close to Kitut river mouth, 7.VI.1932 *Ovchinnikov & Slobodov s.n.* (LE); Low part of Šachdary river, *Tuturin & Bessedin 379* (LE); West Pamir, *Lavrenko & Rodin 945* (LE); West Pamir, *Lavrenko & Rodin 887* (LE). **Turkmenistan**. Central Kopet-Dagh mountains, Distr. Geok-Tepe, between Čuli and Časkon, 29.V.1958 *Čopanov, s.n.* (COI, G, GH, JE, K, LD, W); Prov. Aschabad, *Michelson 234* (G, S, W, WU); Transcaspia region, *Michelson 319* (M, WU); Prov. Zakaspiyskiy, Čuli close to Aschabad, 9.VI.1911 *Seidmuradova s.n.* (LE); Badkhyz region, *Gorelova 3* (LE). **Uzbekistan**. Oy-Badak-Sai deep valley, *Czestnaja 48* (LE). — ***Stipa lingua*** subsp. ***lipskyi***. **Uzbekistan**. Siab river valley, *Michelson 1983* (K); Samarkand district, Samarkand, 29.V.1897 *Lipskyi s.n.* (W); Prov. Buchara: Nura-Tau range at south of Djizlok pass, 26.V.1964 *Priajin s.n.* (LE); North Aktau pass, *Bochantsev & Kamelin 483* (LE). **Tajikistan**. Koyki-Tau mountains at NW of Ljublikar village, 18.V.1960 *Nepli s.n.* (LE); Koyki-Tau mountains, *Bochantsev & Egorova 17* (LE); Zeravshan pass, 3.VI.1932 *Ovczinnikov & Slobodov s.n.* (LE); Zeravshan pass, *Kozlova 355* (LE). **Kazakhstan**. Tian-Shan occid., *Mikeschin 93* (B, FI, G, H, J, L, LE, S, W); Prov. Turgai, *Kraschenninikov 5003* (LE). — ***Stipa lingua*** subsp. ***magnifica***. **Kyrgyzstan**. Čatkalskiy range, Bozbu-Too mountain close to Djuk-Beli pass, 17.V.2005 *Lazkov s.n.* (LE); Prov. Fergana: Sari-Kamysh-Sau gorge close to Tash-Kumyr mountain, 4.V.2005 *Lazkov s.n.* (LE); Prov. Fergana, *Alexeenko 1422* (LE); Prov. Oškaya, *Tzvelev 7* (LE).

Acknowledgements

We thank the staff of B, BM, BR, C, COI, E, FI, G, GH, H, JE, K, L, LD, LE, M, MEL, NY, PR, S, U, UPS, W, WAG and

Table 1. Main morphological differences among three subspecies of *Stipa lingua*.

Characters	subsp. *lingua*	subsp. *magnifica*	subsp. *lipskyi*
Panicle	usually enclosed	exserted or partially enclosed	enclosed or partially enclosed
Sheaths of upper cauline leaves	usually swollen	non-swollen	non-swollen or slightly swollen
Culm internodes	pubescent	glabrous	pubescent
Branches hairs length (mm)	(0.2)0.3–0.4(1.3)	1–2.2(2.5)	(0.1)0.3–0.8(1.1)
Floret (mm)	(12.1)12.5–14(14.8)	(13.7)13.9–15.4(16)	(12.3)13–14(14.5)
Lemma hairs length (mm)	(1.1)1.3–1.6(2.2)	(0.7)1–1.1(1.3)	(1)1.2–1.3(1.4)
Callus indument	glabrous or only ventral surface villous, rarely wholly villous	wholly villous	wholly villous
Awn (cm)	(13.9)16.7–19.7(24.4)	(21.4)23–24.8(28.5)	(13.3)15.9–17.3(18.4)
Column indument	pilose	pilose	tuberculate or scabrous
Seta length (cm)	(11.5)13.5–17.4(22.5)	(19)21–22(26)	(11.1)13.6–15.1(16.2)
Seta hairs length (mm)	(7.6)8.9–10.5(12)	(6.8)7.9–8.9(10.6)	(5.9)6.4–8(8.2)

WU herbaria for the support during our visits and/or lending us selected material. We also are indebted to Dr. Alejandro Quintanar and the two anonymous reviewers for their advice and suggestions on the manuscript. This work was supported by the *Flora iberica* project CGL2008-02982-C03-01/CLI, Ministerio de Educación y Ciencia, Spain.

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Capítulo 2. Una investigación taxonómica numérica de *Stipa* Sect. *Smirnovia* y S. Sect. *Subsmirnovia* (Poaceae). A numerical taxonomic investigation of *Stipa* Sect. *Smirnovia* and *S.* Sect. *Subsmirnovia* (Poaceae)

Resumen

En el presente trabajo se emplean análisis multivariantes y univariantes para estudiar la variabilidad morfológica de las especies de las secciones *Smirnovia* Tzvelev y *Submirnovia* Tzvelev. Se utilizó una matriz de similitud de Gower para el procedimiento MODECLUS y también se empleo un método de agrupación utilizando el algoritmo UPGMA para estudiar como las especies se segregan. Conjuntamente, los caracteres cuantitativos y cualitativos fueron sometidos a diferentes análisis, para determinar que caracteres son los más discriminantes y como se agrupan las diferentes especímenes estudiados. Un total de 18 taxones fueron reconocidos para la sección *Smirnovia*, mientras que solamente se reconoce *S. gaubae* Bor para la sección *Subsmirnovia*, caracterizado por tener el ovario con 3 estilos y las lígulas de las hojas basales muy largas. El estudio ha corroborado la utilidad de caracteres empleados tradicionalmente para distinguir los diferentes taxones, tales como: la longitud de la arista y el lema, indumento de la lema, forma de la arista, indumento de la columna, ratio longitud seta/longitud columna, indumento y forma del callo y el número de estilos del ovario. Igualmente, algunos caracteres no estudiados en detallo han sido de gran importancia en la delimitación de algunas especies, como la presencia de pelos falcados en el callo de *S. caucasica* subsp. *drobovii* y la fusión de las líneas dorsales y subdorsales de la lema de *S. klemenzii*. Finalmente, se ha desarrollado una clave para identificar las especies reconocidas en la secciones *Smirnovia* y *Subsmirnovia*.

Systematic Botany (2012), 37(3): pp. 1–16

DOI 10.1600/036364412X648607

A Numerical Taxonomic Investigation of *Stipa* Sect. *Smirnovia* and *S.* Sect. *Subsmirnovia* (Poaceae)

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Communicating Editor: Fernando Zuloaga

Abstract—Multivariate and univariate analyses were used to investigate the morphological variation among the species of *Stipa* sections *Smirnovia* and *Subsmirnovia*. The MODECLUS procedure using Gower's similarity coefficient and UPGMA were used to discover how the selected specimens segregated. Subsequently different analyses were applied to qualitative and quantitative characters to determine which were the most discriminating and to determine group placement for each specimen. This study recognizes 18 taxa for section *Smirnovia*, whereas section *Subsmirnovia* comprises only one species, *S. gaubae,* which is clearly distinguished by its 3-styled ovary and its long basal leaf ligule. Both qualitative and quantitative characters are necessary for species delimitation. The present work has corroborated previously used diagnostic characters, such as: lemma and awn length, lemma indumentum, awn shape, column indumentum, seta/column length ratio, callus indumentum and shape, presence of coronula, basal leaf ligule cilia, and the number of styles. Likewise, some characters not previously studied in detail, were significant in species delimitation such as the presence of falcate trichomes on the callus of *S. caucasica* subsp. *drobovii* and the subdorsal and lateral rows of fused trichomes in *S. klemenzii*. Finally, a key to species in subsections *Smirnovia* and *Subsmirnovia* is provided.

Keywords—Asia, grass, MODECLUS, multivariate, phenetics, Stipeae.

Stipa L. is classified within the recently expanded tribe Stipeae that comprises between 400 and 600 species and 21 genera (Barkworth et al. 2008; Romaschenko et al. 2007, 2010; Cialdella et al. 2010). *Stipa* is the largest genus with about 300–400 species distributed throughout the temperate and subtropical regions of both hemispheres (Bor 1968; Tzvelev 1976; Cope 1982; Clayton and Renvoize 1986; Moraldo 1986; Freitag 1985; Watson and Dallwitz 1992). Current taxonomies recognize a narrow concept of *Stipa* with several segregate genera: *Hesperostipa* (Elias) Barkworth, *Austrostipa* S. W. L. Jacobs & J. Everett, *Celtica* F. M. Vázquez & Barkworth, *Amelichloa* Arriaga & Barkworth, and *Pappostipa* (Speg.) Romasch., P. M. Peterson & Soreng. As a consequence, *Stipa* s. s. has been reduced to ca. 140 species and is now limited to Asia, Europe, and North Africa (Romaschenko et al. 2007; Barkworth et al. 2008).

Spikelets in *Stipa* are 1-flowered, and the anthecium disarticulates above the glumes leaving a sharp-pointed callus attached at its base. The lemma is often long and narrow, terete, indurate, and strongly convolute, terminating in a prominent awn. The callus, lemma, and the palea considered together is called the anthecium. The awn is unigeniculate or bigeniculate and usually twisted below the first bend. The portion below the bend is referred to as the column and above the bend is referred to as the seta.

Stipa includes some of the most taxonomically difficult species in Poaceae. They exhibit plasticity in morphological characters thus making taxonomic assessments difficult. The lack of stable morphological structures and the difficulty in establishing clear morphological boundaries between taxa, has resulted in the creation of a high number of taxa at the specific and infraspecific ranks (Roshevitz 1916, 1924, 1932, 1934; Martinovský 1980; Kotukhov 1987, 1989, 1991, 1994). These problems were previously pointed out by Tzvelev (1974, 1976), Scholz (1985), Freitag (1985), and Strid (1991).

The infrageneric classification of *Stipa* traditionally has been based on awn features. Dumortier (1824) was the first author who provided an infrageneric classification. Two Sections were recognized: *Eriostipa* Dumort. (= Sect. *Stipa*), that included species with pubescent or plumose awns, and *Leiostipa* Dumort., including those species with scabrous or glabrous awns. The first taxon with unigeniculate and plumose seta was *Stipa caucasica* Schmalh. which was described in 1896. Subsequently, Roshevitz (1932) proposed dividing *Stipa* into seven series, mostly based on awn features. Thus, eight species with unigeniculate awns and plumose seta were included in Ser. *Brevigeniculatae* Roshev. Roshevitz (1932), however, included in this series only those species with columns 1/10–1/8 the length of the seta and excluded *S. caucasica* because its column was 1/4–1/2 the length of the seta. More recently, Tzvelev (1974) considered *S. caucasica* the type species of a newly described Section *Smirnovia*, which included all the species with unigeniculate awns and plumose seta. The most relevant characters besides awn length were the intravaginal branching, acuminate or long acuminate glumes, coriaceous lemmas, terete or laterally compressed lemmas with overlapping margins, acute calluses, and ovaries with two styles. Section *Smirnovia* comprises 18 taxa that are endemic to Asia and the Caucasus with the highest diversity in central Asia with seven endemic species.

Parolly and Scholz (2004) described *S. cacuminis* H. Scholz & Parolly from Turkey as a species transitional between Sections *Barbatae* A. Junge and *Smirnovia*, (and relatively close to *S. hohenackeriana* Trin. & Rupr.) because of its combination of characters: the absence of coronula, an indistinctly unigeniculate awn, and plumose seta with trichomes ca. five mm long. But in our view, those characters bring it closer to *S. turkestanica* Hack. in Sect. *Stipa*, where it is frequent to find specimens whose awns are indistinctly bent in the lower portion. Therefore, *S. cacuminis* is not considered a member of Sect. *Smirnovia* and is therefore excluded from this study.

Additionally, *S. gaubae* Bor, endemic to Azerbaijan and North Iran, was included in the multivariate analysis and is the only species of Sect. *Subsmirnovia* Tzvelev (1976). It can be distinguished from Sect. *Smirnovia* by the presence of three styles and longer ligules (Tzvelev 1993). The similar awn structure and affinity with species of Sect. *Smirnovia*, made it necessary to include *S. gaubae* in the morphometric analyses.

Several species of Sections *Smirnovia* and *Subsmirnovia* have been included in floras or regional studies, but a

Capítulo 3. Revisión taxonómica de *Stipa* sección *Smirnovia* y sección *Subsmirnovia* (Poaceae). [Taxonomic revision of *Stipa* section *Smirnovia* and section *Subsmirnovia* (Poaceae).

Resumen

En el presento trabajo se ha realizado una revisión taxonómica de las especies de las secciones *Smirnovia* Tzvelev y *Subsmirnovia* Tzvelev, basado en un estudio exhaustivo del material de herbario. El estudio de la variabilidad morfológica se analizó sobre un total de de 702 pliegos procedentes de 32 herbarios diferentes. El estudio ha resultado en el reconocimiento de 18 taxones (13 especies y cinco subespecies) para la sección *Smirnovia*, caracterizado por tener la arista unigeniculada con la columna glabra o pelosa, la seta plumosa y el ovario con dos estilos. Los taxones de la sección *Smirnovia* se distribuyen principalmente por Asia Central. Sección *Subsmirnovia* está constituido por una única especie, *S. gaubae* Bor, endémica de noroeste de Irán y del sur de Azerbaiyán. *Stipa gaubae* comparte las características de la arista con la sección *Smirnovia*, pero se diferencia claramente por sus largas lígulas y los tres estilos del ovario. Se proporciona un clave para especies y subespecies, además cada taxon va provisto de sinónimos, una descripción morfológica detallada, ilustraciones y mapas de distribución. Nueve lectotipos han sido designados.

The LINNEAN SOCIETY of London BOTANICAL Journal of the Linnean Society

Botanical Journal of the Linnean Society, 2011, **167**, 394–448. With 22 figures

Taxonomic revision of *Stipa* section *Smirnovia* and section *Subsmirnovia* (Poaceae)

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Received 6 July 2010; revised 21 January 2011; accepted for publication 3 September 2011

A comprehensive taxonomic revision of *Stipa* section *Smirnovia* and section *Subsmirnovia* is proposed on the basis of a critical morphological analysis of extensive herbarium material. The morphological variation was analysed by the study of 702 vouchers from 32 different herbaria. The revision of section *Smirnovia* results in the recognition of 18 taxa (13 species and five subspecies) characterized by a unigeniculate awn with a glabrous to pilose column, a plumose seta and an ovary with two styles. The taxa of section *Smirnovia* are mainly distributed in central Asia. Section *Subsmirnovia* comprises only one species, *S. gaubae*, restricted to north-west Iran and southern Azerbaijan. *Stipa gaubae* shares the same awn features as section *Smirnovia*, but is clearly differentiated by its longer ligules and three-styled ovary. Keys to species and subspecies, and synonymy, detailed morphometric descriptions, illustrations and distribution maps are provided for most of the taxa. Nine lectotypes are designated. *Botanical Journal of the Linnean Society*, 2011, **167**, 394–448.

ADDITIONAL KEYWORDS: Asia – Caucasus – Stipeae – taxonomy.

INTRODUCTION

The genus *Stipa* L. (Poaceae) is classified within the large tribe Stipeae, which is mainly characterized by spikelets with only one anthecium, glumes equalling or longer than the lemma, a deciduous or nondeciduous apical awn, two or three lodicules (Clayton & Renvoize, 1986) and a small chromosome complement based on $x = 10–12$ (Tzvelev, 1976; Freitag, 1985; Romaschenko *et al*., 2007). Tribe Stipeae has generally been considered to be a well-defined monophyletic group (Peñailillo, 1996; Hsiao *et al*., 1999; Jacobs, Barkworth & Hsiao, 2000; Jacobs *et al*., 2007), but its generic circumscription has been controversial and has changed dramatically in recent decades.

The major area of uncertainty has been in the circumscription of *Stipa s.l.* (Jacobs *et al*., 2007). In the last 50 years, 300–400 species of *Stipa* have been recognized, distributed throughout the temperate and subtropical regions of both hemispheres (Bor, 1970; Tzvelev, 1976; Cope, 1982; Freitag, 1985; Clayton & Renvoize, 1986; Moraldo, 1986; Watson & Dallwitz, 1992). Nowadays, the broad circumscription has been changed by the resurrection of previously described genera, and several subgenera have been raised to the generic level. In addition, during the last few decades, new genera have been established [*Amelichloa* Arriaga & Barkworth, *Austrostipa* S.W.L.Jacobs & J.Everett, *Celtica* F.M.Vázquez & Barkworth, *Hesperostipa* (M.K.Elias) Barkworth and *Pappostipa* (Speg.) Romasch., P.M.Peterson & Soreng]. One consequence of these changes is that *Stipa s.s.* has been reduced considerably to around 140 species (Barkworth *et al*., 2008), and confined geographically to Asia, Europe and North Africa (Romaschenko *et al*., 2007; Barkworth *et al*., 2008).

Dumortier (1823), in his '*Observations sur les Graminées de la flore de Belgique*', was the first author to provide an infrageneric system, including two sections based on awn features: *Eriostipa* Dumort. (= section *Stipa*), with hairy or plumose awns, and section *Leiostipa* Dumort., with scabrous or glabrous awns. Since Linneaus and Dumortier, around 120 additional genera and infrageneric taxa

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have been described in tribe Stipeae, and many specific and infraspecific names have been published in complex taxonomic systems (Trinius & Ruprecht, 1842; Ascherson & Graebner, 1899; Hitchcock, 1925; Martinovský, 1972, 1980; Klokov & Osychnyuk, 1976).

The group of species placed in *Stipa s.l.* is taxonomically complex, exhibiting much plasticity in morphological characters, partly attributable to the wide range of environmental stresses and the wide distribution of the genus (Freitag, 1985). Consequently, the lack of stable morphological features and the difficulty in establishing clear morphological boundaries between the taxa have promoted the naming of a large number of taxa at specific and infraspecific ranks (Roshevitz, 1916, 1924, 1932, 1934; Smirnow, 1925, 1926, 1929, 1938; Martinovský, 1980; Kotukhov, 1987, 1989, 1991, 1994). This problem was pointed out by Tzvelev (1974, 1976), Scholz (1985) and Freitag (1985), who reduced the number of accepted species in *Stipa*.

Roshevitz (1934), in his treatment for the former Soviet Union, organized the genus *Stipa* into seven series based on differences in the awn structure. Those taxa with unigeniculate awns and the column one-ninth to one-tenth as long as the seta were included in series *Brevigeniculatae* Roshev., with eight species confined to Central Asia. However, *S. caucasica* Schmalh., with a longer column, was excluded and placed in series *Barbatae* Roshev., which was characterized mainly by its completely hairy awn. More recently, Tzvelev (1976) distinguished eight sections for the former Soviet Union. Those taxa with unigeniculate awns were placed in section *Smirnovia* Tzvelev, which included 14 species, with *S. caucasica* being the type species. In addition to the unigeniculate awn, Tzvelev also mentioned several distinguishing features, including intravaginal branches, glumes acuminate or long acuminate, lemma coriaceous, terete or laterally compressed and with overlapping margins, callus acute and two styles (Tzvelev, 1974). The species mainly range from the Caucasus to western China and southern Siberia, reaching their highest diversity in Central Asia.

Section *Subsmirnovia* Tzvelev was described (Tzvelev, 1974) as comprising only *S. gaubae* Bor, endemic to north Iran and Azerbaijan. Initially, *S. gaubae* was placed by Bor (1970) in series *Brevigeniculatae* (= section *Smirnovia*) on the basis of the distinct unigeniculate awn, but Freitag (1985) placed it in section *Barbatae* A.Junge on the basis of the long ligules and the three-styled ovary. The affinity of this species is still unclear and therefore, in agreement with Tzvelev (1976), it is better included in the monospecific section *Subsmirnovia*. In fact, the awn features are similar to those of section *Smirnovia* and, for this reason, we have included *S. gaubae* in this revision.

Furthermore, five species with indistinctly unigeniculate or sub-bigeniculate awns are closely related to section *Smirnovia*. This character suggests a possible hybrid origin from *S. caucasica* and other species of section *Stipa* (Smirnow, 1929; Tzvelev, 1974). Tzvelev (1976) initially included them in section *Smirnovia* and, subsequently, in section *Stipa* (Tzvelev, 2006). In addition to the awn geniculation, they have qualitative characters that favour their inclusion in section *Smirnovia*, such as the presence of a coronula or scattered hairs at the lemma apex, and the straight or falcate seta (except for *S. gegarkunii* P.A.Smirn. and *S. okmirii Dengub*., in which the seta is flexuous), whereas the species of section *Stipa* always exhibit a glabrous lemma apex and a flexuous seta. The affinity of these species is still unclear and, before more material is obtained and molecular analyses help to clarify their systematic position, we consider that they are better included in section *Smirnovia*.

Most of the species in both sections have been partially investigated in several floras or regional studies: Goloskokov (1969) recognized four species for Kazakhstan, Ovczinnikov (1957) recognized six species for Tajikistan, Pazij (1968) recognized ten species for Middle Asia and Lomonosova (2000) recognized three species for Siberia. The revision by Tzvelev (1976), who recognized 14 species and four subspecies for the former Soviet Union, is the most comprehensive study to date. In order to solve many of the delimitation problems and to include those species published after Tzvelev's work and those specimens from outside the former Soviet Union, we present a new taxonomic revision based on the study of herbarium material. Nineteen taxa in two sections are recognized: 13 species and five subspecies for section *Smirnovia* and one species for section *Subsmirnovia*.

MATERIAL AND METHODS

This revision is based on the study of 702 herbarium specimens (see Appendix) from the following herbaria: B, BOLO, BR, C, COI, E, ERE, FI, G, GDA, GH, GOET, H, HBG, JE, K, L, LD, LE, M, MA, MEL, NY, PR, RO, SI, T, TK, U, W, WAG and WU. Digital images were also examined from TAK and NS. We had some difficulty in obtaining material of some types and species from Asian herbaria and, when it was not possible to find type material for some taxa, synonymy was based on the description in the protologue or its taxonomic treatment in previous floras.

Morphometric measurements were carried out on 188 herbarium specimens using a Mitutoyo CD-15CD digital calliper. In most cases, one specimen per voucher was selected when sufficient material was available. All the characters were selected according to common use in the taxonomy of Stipeae after previous examination of its variability in the herbarium material. In addition, several new characters were examined and found to be reliable. The vouchers were selected to cover the greatest morphological variation found and to include the entire set of organs corresponding to the selected characters. The measurements on the spikelets were performed on the distal spikelets of the second most apical axis of the panicle, and on the longest branch. The length of the basal blades was taken from the second leaf and the width at 2 cm from the ligule; the width of the awn was taken at 5 mm from the base. For all characters, exploratory analyses, including descriptive statistics for quantitative characters and box plots, were performed using the STATISTICA (http://www.statsoft.com) package to develop detailed morphological descriptions for each recognized taxon on the basis of quantitative and qualitative data.

Additional data related to the habitat, distribution and chromosome number were based on the literature and information on the collection labels. The distribution data were used to build detailed distribution maps, with the program ArcView GIS v. 3.2 for Windows.

Transverse sections of basal leaves were obtained with a Bright Starlet 2212 Cryostat, stained with Fasga mixture (Tolivia & Tolivia, 1987) and photographed under optical microscopy. Idiograms of these were drawn by J. L. Castillo.

TAXONOMIC CHARACTERS

Habit

All species of *Stipa* section *Smirnovia* and section *Subsmirnovia* are perennial grasses. All are more or less xerophilous, exhibiting intravaginal growth, with many vegetative shoots and few generative shoots, resulting in more or less caespitose and tufted habits, referred to as a 'rosulate perennial growth form' by Freitag (1985).

Vegetative body

The culms are straight or slightly curved, with two to four (or five) nodes, and are usually not longer than 80 cm. Nevertheless, the size of the plant is highly correlated with its elevational range. For instance, the widespread *S. caucasica* ranges from 7 to 68 cm in height, whereas, in species with more limited ranges, the variation is much smaller, e.g. *S. klemenzii* Roshev. ranges from 8 to 25 cm in height. Culm nodes may be glabrous or pilose. The ornamentation of the culm is different below the nodes and on the rest of its surface, being pubescent below the node and minutely pubescent, papillose or glabrous on the rest.

Leaves

The sheath, the size and the surface of the blades can be highly variable in the same plant, depending on whether it is the basal leaf or the culm leaf. Likewise, the surface ornamentation varies along the length of the leaf and with its age.

Sheath

The sheath exhibits great variation, even in the same specimen, and usually shows different surface ornamentation depending on whether it is a basal leaf or a culm leaf. The basal leaf sheaths are glabrous, somewhat scabrous or minutely pubescent. The surface of the upper sheaths differs depending on the distance to the blade and to the sheath margins. Thus, many of the species are pubescent, aculeate or papillose close to the blade and next to the margins, whereas the rest are glabrous. In all species of section *Smirnovia*, the basal leaf sheath is ciliate, but cilia are usually absent on the culm leaves. Only *S. lingua* A.Junge and *S. gaubae* have cilia on the culm leaves in most of the specimens.

Blades

Most of these plants occupy more or less xeric areas, exhibiting convolute or involute blades, which more rarely are flat in *S. lingua* subsp. *magnifica* (A.Junge) R.Gonzalo and *S. gaubae*. As a result of the high degree of variability, especially in species with large distributions (*S. caucasica*, *S. lingua* and *S. tianschanica* Roshev.), blade features have been considered as a secondary criterion to support species boundaries, after the spikelet morphology. These features are variable along the length of the blade and with its age. Therefore, for the description of these characters, we have considered only the lower section of mature leaves. The abaxial surface may be glabrous, minutely scabrous, scabrous or scattered aculeate, whereas the adaxial surface may be scabrous, minutely pubescent or pubescent.

The histology of the leaf blades of *Stipa* has been studied extensively (Metcalfe, 1960; Martinovský, 1965; Caro, 1966; Caro & Sánchez, 1973; Barkworth, 1981; Devesa, 1992). However, none of the species from section *Smirnovia* and section *Sub-*

smirnovia have been examined previously. *Stipa* sections *Smirnovia* and *Subsmirnovia* are C3 grasses (XyMS+), leaf blades with adaxial ribs or 'nodular' in transverse section (Watson & Dallwitz, 1992) and mesophyll with nonradiate chlorenchyma. The abaxial surface of the leaf blades has a regular outline, whereas the adaxial surface is divided into conspicuous ribs of unequal size, separated by deep and narrow furrows with 'V', 'U' or 'W' shapes (Figs 5, 10, 15, 22). The number of ribs ranges from five to 11, and is closely related to the width of the leaf. The apices of the ribs may be rounded, quadrangular or have a slight depression (Figs 5, 10, 15, 22). Bulliform cells are displayed at discrete fan-shaped groups of three to five cells at the base of the furrows, and are usually small and inconspicuous (Figs 10D, 15H).

Vascular bundles are more or less embedded in the middle of the mesophyll, and the number is correlated with the number of ribs. Two different kinds of vascular bundle are found, which typically alternate with one another (Figs 5D, 20B). Each rib corresponds to one vascular bundle of the 'basic type' (Metcalfe, 1960), accompanied by sclerenchyma girders reaching both sides of the blades (Fig. 22G), or only the abaxial side in the case of less developed ribs (Fig. 15E). Usually each furrow displays, alternating with the ribs, a 'small bundle' without girders, or only joining at the abaxial surface. Xerophily of the species in these two sections is reflected in the number of continuous abaxial subepidermal layers connecting the abaxial girders to each other. Those species inhabiting strongly xeric habitats exhibit a much stronger development of these girders and layers. Thus, populations of *S. klemenzii* and *S. caucasica* (Figs 5B, 15H) from more mesophytic habitats have layers two cells thick, whereas *S. lingua* subsp. *lingua* (Fig. 10C) and *S. caucasica* from more xerophytic habitats show layers six cells thick. This layer is discontinuous and narrow at the adaxial surface, often interrupted at the furrows (Figs 5, 10, 15, 22).

Ligules

Despite the difference in size and shape between ligules of the culm leaves and those of the basal leaves (usually increasing in size from the base), their features and size allow the recognition of several groups. Thus, basal ligules may be reduced to a line of dense hairs or very shortly truncate (*c.* 0.4 mm in length) and ciliate, as in several species of section *Smirnovia* (*S. caucasica*, *S. aktauensis* Roshev., *S. karataviensis* Roshev., *S. lingua* and *S. longiplumosa* Roshev.). Other species, however, share truncate, rounded or obtuse ligules up to 2.5 mm in length, ciliate or with glabrous margins, as in *S. mongolorum* Tzvelev, *S. klemenzii*, *S. tianschanica*, *S. gegarkunii*, *S. alaica* Pazij, *S. okmirii*, *S. talassica* Pazij and *S. kopetdaghensis* Czopanov. *Stipa gaubae*, with lanceolate or lacerate ligules up to 12.3 mm in length, is clearly distinguishable from species in section *Smirnovia*.

Inflorescences

The inflorescence is contracted, paniculate, with erect to erect-spreading branches, and usually bearing few spikelets, except in *S. mongolorum*, which has an open panicle because of its spreading branches. The panicles may be exserted, partially enclosed or enclosed by the upper sheath or sheaths, depending on the length of the first culm internode and on the developmental stage of the inflorescence. Information about the surface ornamentation of the first internode has been included in the descriptions, but this feature lacks relevance for the delimitation of taxa.

It is not uncommon for *S. mongolorum* to form a second inflorescence not easily distinguished from the main one. As pointed out by Vickery, Jacobs & Everett (1986) for *Austrostipa*, this could appear during periods of stress.

Glumes

Each spikelet has only one floret, without a rachilla extension and enclosed by two membranous equal or subequal glumes that always exceed the lemma. The glumes are acuminate or long acuminate, with three or seven nerves, with the central nerve reaching the top, and the rest ending gradually towards the apex. The glumes are normally glabrous, but, in some specimens of *S. caucasica*, they are scabrous when becoming acuminate. The upper glume is slightly shorter than the lower glume. With the exception of *S. lingua* subsp. *lipskyi* (Roshev.) R.Gonzalo and *S. karataviensis*, all taxa may have a ciliate central nerve, but the presence and the size of the cilia are of less importance for species recognition. The size of the glumes is quite valuable for inter- and intraspecific delimitation. Widely distributed species exhibit more variability in length (e.g. *S. caucasica*: length, 1.8–6.1 cm), whereas species with a narrow area are more constant (e.g. *S. mongolorum*: length, 1.4–1.9 cm). When measuring the glumes in *Stipa*, it is important to take into account that the tips are delicate and break easily.

Anthecium

For this work, the anthecium consists of the lemma, palea and basal extension (callus). For convenience,

the awn is not included in the length of the anthecium. In section *Smirnovia*, the anthecium is coriaceous with overlapping margins and encloses the flower and the caryopsis inside; for this reason, the species were considered to be cleistogamous by Freitag (1985). However, in these 'cleistogamous' flowers, it is possible to observe anthers and styles exposed between the lemma and the palea, allowing cross-pollination. Despite having useful diagnostic characters, the structures enclosed by the anthecium, including the palea, stamens, lodicules and ovary, are awkward to observe. Generally, in floristic treatments of *Stipa*, what has been measured as the length of the lemma is actually the length of the anthecium.

Lemma

With the awn, the lemma contains the most significant diagnostic characters. The lemma surface presents erect to spreading hairs varying in distribution pattern. The most common pattern is hairs arranged in seven rows, the length of which is variable even in the same species. Occasionally, these rows are diffuse. One particular case is *S. karataviensis*, with only three rows of hairs (one dorsal and two ventral). The lemma in *S. mongolorum* and *S. gaubae* is completely covered or covered up to three-quarters of its length by a dense indumentum. Near the lemma apex, the surface may be glabrous, apparently granular by small tubercles or papillae, aculeate or with small hairs.

The apex of the lemma is sometimes extended into two small tips (lobes) surpassing the awn insertion. Below the awn–lemma junction, there are frequently scattered hairs in *S. alaica*, *S. mongolorum*, *S. gegarkunii*, *S. talassica* and *S. kopetdaghensis*, or they are replaced by a more or less complete ring of hairs around the base of the awn, called a coronula (Freitag, 1985), in *S. caucasica*, *S. aktauensis*, *S. lingua*, *S. tianschanica* subsp. *tianschanica* and *S. okmirii*. However, *S. karataviensis*, *S. klemenzii*, *S. tianschanica* subsp. *gobica* (Roshev.) P.C.Kuo & Y.H.Sun, *S. longiplumosa* and *S. gaubae* are glabrous below the insertion of the awn.

Callus

The callus consists mainly of rachilla tissue, which results in a pungent point at the base of the anthecium being the tie point with the glumes (Vickery *et al.*, 1986). The callus has a cylindrical shape, usually hidden by the hairs, with a lowermost part acute, pungent, oblique and curved, comprising the scar surrounded by the peripheral ring (Freitag, 1985). The callus is usually covered by straight, antrorse hairs, with the ventral hairs longer than the dorsal hairs. An exception has been found in *S. caucasica* subsp. *drobovii* Tzvelev, which has falcate hairs along the dorsal side that are longer than the straight ventral hairs. However *S. lingua* subsp. *lingua* and *S. karataviensis* are glabrous or only display a few hairs on the dorsal side. The shape of the scar may be circular to elliptic, and the peripheral ring dorsally flattened and much protruding (Freitag, 1985). In addition, *S. lingua* and *S. karataviensis* have an expanded foot-like base.

Palea

The palea is enclosed by the lemma, and their lengths are relatively similar. The presence of a line of hairs between the two veins appears consistently in *S. mongolorum*, *S. aktauensis* and *S. gaubae.* However, the other species of section *Smirnovia* have a glabrous palea or, occasionally, one line of hairs.

Lodicules

There are three lodicules, one (ventral) contiguous with the palea and two (dorsal) flanking the dorsal side of the mature caryopsis. The dorsal lodicules are lanceolate, whereas the ventral lodicule is lanceolate or linear-lanceolate and slightly longer or shorter than the dorsal one.

Awn

The features of the awn are the most distinctive in *Stipa*. The length of the awn is a useful character for the taxonomy of the genus, ranging from a few millimetres (e.g. *S. concinna* Hook.f.: length, 8–13 mm) to 50 cm in length (e.g. *S. pulcherrima* K.Koch). As for the other structures of the spikelet, intraspecific variation is higher in those species that are widely distributed, notably *S. caucasica* and *S. lingua*.

The awn is divided into two parts, the column and seta (also called the bristle). The column is the basal part of the awn, which is bent once or slightly bent twice and twisted in sections *Smirnovia* and *Subsmirnovia*. The surface of the column is pilose in *S. caucasica*, *S. lingua*, *S. aktauensis* and *S. mongolorum* and glabrous or tuberculate in the other species of section *Smirnovia* and in *S. gaubae*.

The seta is plumose, although specimens of *S. caucasica* may display hairs only on one side of the seta. The hairs range from rather long [*S. longiplumosa* (8.2)8.7–10.0(12.0) mm] to short [*S. mongolorum* (2.3)2.6–3.9(4.3) mm]. The seta shape varies from straight in *S. mongolorum*, *S. aktauensis*, *S. karataviensis*, *S. lingua*, *S. tianschanica*, *S. longiplumosa*, *S. talassica* and *S. gaubae* to falcate in

S. caucasica, *S. klemenzii*, *S. alaica* and *S. kopet-daghensis*. Two exceptions are found in *S. gegarkunii* and *S. okmirii*, which have a flexuous seta. Another important taxonomic character is the difference in length between the column and the seta, ranging from the column being one-seventh to one-tenth of the seta in *S. mongolorum*, *S. lingua*, *S. gaubae* and *S. aktauensis* to one-third to one-sixth in the rest of the species.

Stamens

There are three equal stamens per anthecium, the size varying in proportion to the length of the lemma. The absence or presence of hairs at the apex occurs in different specimens of the same species and, as a consequence, stamens do not provide useful diagnostic characters.

Ovary and Caryopsis

Ovaries are similar in all species, glabrous, with two styles (section *Smirnovia*) and three styles in *S. gaubae* (section *Subsmirnovia*). The mature caryopsis is fusiform, with a linear hilum that almost reaches the top, and the size varies in proportion to the length of the lemma.

Key to taxa

1. Column hairy for its whole length 2
1. Column glabrous, tuberculate or scabrous, rarely with a few hairs near the bend 8
2. Column/seta ratio = (2.1)2.8–3.5(6.3); seta falcate 3
2. Column/seta ratio = (4.2)7.6–9.8(14); seta straight 5
3. Callus (1.07)1.20–1.34(1.57) mm long, dorsal hairs falcate and longer than ventral ones ..... 1c. *S. caucasica* subsp. *drobovii*
3. Callus (1.62)1.95–2.47(2.82) mm long, dorsal hairs straight and shorter than ventral ones 4
4. Abaxial surface of basal leaves usually scabrous; glumes (1.8)2.1–2.4(2.8) cm long; anthecium (7.4)7.8–8.9(9.5) mm long; awn (4.5)5.1–5.8(8.0) cm long ..... 1b. *S. caucasica* subsp. *glareosa*
4. Abaxial surface of basal leaves usually glabrous; glumes (3.1)4.2–3.6(6.0) cm long; anthecium (9.6)10.0–12.4(13.1) mm long; awn (7.0)7.9–10.7(13.4) cm long ..... 1a. *S. caucasica* subsp. *caucasica*
5. Anthecium (3.7)6.3–7.2(8.0) mm long; lemma hairy throughout; awn (4.4)5.7–6.8(7.7) cm long; seta with hairs (2.3)2.6–3.9(4.3) mm long ..... 2. *S. mongolorum*
5. Anthecium (9.9)11.5–14.1(16.0) mm long; lemma with seven distinct rows of hairs; awn (10.8)14.2–22.1(28.1) cm long; seta with hairs (3.9)6.2–9.4(12.0) mm long 6
6. Glumes (3.4)3.6–4.3(4.7) cm long; anthecium (9.9)10.0–11.2(11.5) mm long; awn (10.8)11.7–14.5(15.4) mm long; seta with hairs (3.2)4.5–5.5(6.3) mm long ..... 3. *S. aktauensis*
6. Glumes (6)6.8–8(9.1) cm long; anthecium (12.1)13.3–14.5(16.0) mm long; awn (13.9)16.9–24.4(28.5) mm long; seta with hairs (6.8)8.0–10.4(12.0) mm long 7
7. Panicle branches with hairs (0.2)0.3–0.4(1.3) mm long; culms below the nodes pilose; dorsal side of the callus usually glabrous; seta (13.9)16.7–19.7(24.4) cm long ..... 4a. *S. lingua* subsp. *lingua*
7. Panicle branches with hairs 1.0–2.2(2.5) mm long; culms below the nodes glabrous; dorsal side of the callus villous; seta (19)21–22(26) cm long ..... 4c. *S. lingua* subsp. *magnifica*
8. Lemma hairy throughout or up to three-quarters the length of the lemma; styles three ..... 14. *S. gaubae*
8. Lemma with three to seven distinct rows of hairs; styles two 9
9. Lemma with three distinct rows, more rarely with five rows of hairs; callus glabrous ..... 5. *S. karataviensis*
9. Lemma with seven distinct rows of hairs; callus villous 10
10. Awn straight; callus with foot-like expansion or not 11
10. Awn flexuous or falcate; callus base not expanded 15
11. Glumes (2.2)2.7–2.9(3.2) cm long; anthecium (7.2)8.2–8.9(9.4) mm long; awn (6.0)6.3–8.1(9.3) mm long 12
11. Glumes (4.8)5.6–7.5(9.0) cm long; anthecium (12.3)13.0–13.9(14.7) mm long; awn (13.3)17.0–22.0(25.0) cm long 13
12. Glumes (2.2)2.7–2.9(3.2) cm long; awn (6.5)7.8–8.3(9.3) cm long; anthecium with coronula ..... 6a. *S. tianschanica* subsp. *tianschanica*
12. Glumes (1.90)2.15–2.4.0(2.70) cm long; awn (6.0)6.3–7.3(8.0) cm long; anthecium apex glabrous, rarely with scattered hairs ..... 6b. *S. tianschanica* subsp. *gobica*
13. Awn (13.3)15.9–17.3(18.4) cm long; callus (1.5)1.7–2.1(2.2) mm long; blades abaxial surface glabrous, adaxial surface pilose ..... 4b. *S.lingua* subsp. *lipskyi*
13. Awn (19.0)19.8–23.6(25.1) cm long; callus (2.3)2.4–2.7(2.8) mm long; blades abaxial surface scabrous, adaxial surface scabrous or papillose (rarely minutely pubescent) 14

14. Ligule replaced by a line of hairs or shortly truncate up to 0.15 mm long; column glabrous; seta with hairs (8.2)8.7–10.0(12.0) mm long ..... 8. *S. longiplumosa*
14. Ligule 0.89–1.70 mm long, rounded; column somewhat scabrous, seta with hairs 5.20–5.31 mm long ..... 13. *S. talassica*
15. Glumes (1.90)2.15–2.40(2.70) cm long; anthecium (7.2)8.1–8.8(9.3) mm long; awn (6.0)6.3–7.3(8.0) cm long ..... 6. *S. tianschanica* subsp. *gobica*
15. Glumes (3.1)4.0–6.2(9.0) cm long; anthecium (9.6)11.0–15.2(19.8) mm long; awn (9.8)13.3–19.9(28.4) cm long 16
16. Seta falcate 17
16. Seta flexuous 19
17. Lemma apex glabrous, peripheral ring (0.35)0.45–0.58(0.63) mm long; awn (9.9)11.3–13.2(14.0) cm long; lemma subdorsal and lateral rows of hairs fused for three-quarters of their length ..... 7. *S. klemenzii*
17. Lemma apex with scattered hairs or with coronula, peripheral ring (0.70)0.76–0.86(0.93) mm long; awn (12.4)14.2–16.5(17.7) cm long; lemma with distinct rows of hairs fused for three-quarters of their length 18
18. Blades abaxial surface glabrous; anthecium (10.1)11.3–12.5(12.6) mm long, with erect-spreading hairs; column (2.3)3.2-3.6(4) cm long ..... 9. *S. alaica*
18. Blades abaxial surface distinctly scabrous; anthecium 13.0–14.4 mm long, with erect hairs; column 4.3–4.7 cm long ..... 10. *S. kopetdaghensis*
19. Anthecium (16.1)17.1–18.1(19.8) mm long, the ventral row reaching the top or ending not less than 0.33 mm below the top; blades abaxial surface glabrous and adaxial surface papillose ..... 11. *S. gegarkunii*
19. Anthecium (12.7)13.8–15.2(15.5) mm long, the ventral row ending 2.0–2.5 mm below the top; blades abaxial surface distinctly scabrous and adaxial surface pilose or minutely pubescent 20
20. Lemma with coronula; blades adaxial surface pilose, with hairs *c.* 0.5 mm; glumes (6.0)6.1–6.7(6.8) cm long; awn 22.4–24.5 cm long ..... 12. *S. okmirii*
20. Lemma apex glabrous or with scattered hairs; blades adaxial surface minutely pubescent with hairs up to 0.1 mm long; glumes 5.3–5.6 cm long; awn 19.8–21.3 cm long ..... 13. *S. talassica*

TAXONOMIC TREATMENT

SECTION I. *SMIRNOVIA* TZVELEV

Section *Smirnovia* Tzvelev, Novosti Sist. Vyssh. Rast. 11: 20. 1974. *Type: S. caucasica* Schmalh.

Series *Brevigeniculatae* Roshev. in V.L. Komarov (ed.), Fl. URSS 2: 85. 1934. *Type: S. lingua* A.Junge (lectotype, here designated).

Herbs densely caespitose, perennial; branching intravaginal. Culms two- to four-noded, erect or slightly curved. Basal leaves convolute, involute (rarely plane or conduplicate); ligules truncate, rounded, obtuse or lacerate, or replaced by a line of hairs. Panicle usually contracted, with the branches usually erect or erect-spreading. Glumes equal or subequal, lanceolate, acuminate, three- to five-nerved. Anthecium coriaceous, fusiform or laterally compressed; lemma with three to seven rows of hairs, or completely covered by soft antrorse hairs; lemma apex with coronula, with scattered hairs or glabrous; callus acute, curved, villous or glabrous, sometimes with foot-like expanded, scar elliptic to circular, peripheral ring dorsally flattened and protruding. Palea lanceolate, two-nerved and equalling or slightly shorter than lemma; lodicules three, equal or subequal, acute, membranous, lanceolate or linear-lanceolate. Awn unigeniculate or slightly bigeniculate; column glabrous, scabrous or hairy; seta straight, falcate or flexuous, plumose. Ovary glabrous, styles two.

1. Stipa caucasica Schmalh

Stipa caucasica Schmalh., Ber. Deutsch. Bot. Ges. 10: 293. 1892. *Type:* RUSSIA. Temir-Khan-Shura, 6.v.1891, *Lipsky s.n.* (lectotype: designated by Tzvelev 1972, LE!; isolectotypes: LE!).

Herbs 8–66 cm tall, perennial, densely caespitose; branching intravaginal. Culms two- to four-(to five-)noded, nodes pubescent or glabrous, also pubescent above the node, violet; culm internode usually pubescent. Basal leaves 5–43 cm long, green, eventually pruinose; sheaths scabrous, papillose or minutely pubescent, usually ciliate, cilia (0.08)0.40–0.90(1.70) mm long; blades 3–31 cm long, (0.25)0.40–0.60(0.96) mm in diameter, convolute or involute, abaxial surface glabrous, distinctly scabrous or scabrous, adaxial surface papillose, minutely pubescent or pubescent, hairs(0.02)0.08–0.30(0.75) mm long; ligules (0)0.1–0.3(0.7) mm long, rounded, truncate or replaced by a line of hairs, pilose, ciliate, cilia (0.2)0.5–1.0(1.8) mm long. Floriferous culm leaves 4–21 cm long; sheaths 2–18 cm long, the upper sheath sometimes swollen, pilose, papillose or scabrous (rarely glabrous), either pilose or scabrous near the apex and the remainder glabrous or papillose,

margins glabrous or ciliate; blades 0.3–9.3 cm long, (0.10)0.30–0.46(0.93) mm in diameter, abaxial surface glabrous or scabrous, adaxial surface papillose, minutely pubescent or pubescent, hairs (0.01)0.08–0.20(0.75) mm long; ligules 0.20–1.08(2.36) mm long, truncate, rounded, lacerate or replaced by a line of hairs, pilose or scabrous, ciliate, cilia (0.10)0.32–0.64(1.38) mm long. Panicle (3)6–13(31) cm long, contracted, exserted or partially enclosed by the upper leaf sheath (3)4–5(6)-noded; basal internode (0.1)0.3–6.9(11.9) cm long (sometimes lacking), glabrous, scabrous or minutely pubescent (rarely with long hairs); branches (0.9)1.4–2.8(5.5) cm long, erect or erect-spreading, setose, setae (0.03)0.21–0.51(1.75) mm long; basal node with one to three branches with one to four spikelets each. Glumes subequal, lanceolate, acuminate or long acuminate, glabrous (rarely scabrous), rarely ciliate on the central nerves, cilia (0.025)0.10–0.35(0.85) mm long, green and usually purplish tinged, with the margins and tip usually hyaline, lower glume (1.9)2.4–4.0(6.1) cm long and (1)3–5(6)-nerved, upper glume (1.8)2.3–3.8(5.7) cm long and (3)5–6(7)-nerved. Anthecium (7.4)9.0–10.7(13.2) mm long, (0.60)0.77–1.00(1.20) mm wide, fusiform, coriaceous, pale, green or brown (sometimes purple tinged); lemma (5.3)6.7–9.2(11.9) mm long, papillose or aculeate near the apex, with seven distinct or diffuse rows of erect or erect-spreading (rarely spreading) hairs, the ventral row reaching the top or ending 0.5–1.6 mm below, the dorsal row reaching the top or ending (0.2)0.7–2.2(5.6) mm below, the remaining rows reaching the top or ± equalling the dorsal row, hairs (0.45)0.67–1.32(1.72) mm long; coronula (rarely with scattered hairs), hairs (0.42)0.73–1.30(2.17) mm long; callus (1.1)1.4–2.4(2.8) mm long, acute, curved, villous, hairs (1)1.3–1.82(2.42) mm long on the ventral face and (0.55)0.82–1.77(2.80) mm long on the dorsal face, scar circular or ± elliptic, peripheral ring (0.45)0.58–0.90(1.13) mm long, (0.11)0.17–0.28(0.40) mm wide [ratio width/length = (0.21)0.24–0.38(0.43)]; palea (5.32)6.62–9.05(10.91) mm long, lanceolate, membranous, margins and tip hyaline, dorsally two-nerved, papillose or papillose between the nerves (rarely with a dorsal line of hairs) and the remainder glabrous, tip glabrous or ciliate, up to two-thirds to one-half its length, pale, green; lodicules three, equal or subequal, with the dorsal ones slightly longer or shorter than the ventral one, acute, lanceolate or linear-lanceolate, hyaline, glabrous, dorsal lodicules (1.05)1.64–2.45(3.87) mm long, ventral lodicule (0.87)1.50–2.42(2.96) mm long. Awn (4.5)5.9–8.6(14.2) cm long, unigeniculate; column (0.7)1.4–2.2(3.2) cm long, base (0.31)0.38–0.50(0.71) mm in diameter, twisted, pale brown, brown or green and brown (sometimes with purple stains), hairy, hairs at the base of the column (0.41)0.86–1.75(2.88) mm long, (0.75)2.00–3.10(4.03) mm long below the geniculation; seta (3.2)4.5–6.6(11) cm long [ratio column length/seta length = (0.16)0.26–0.4(0.47)], falcate (rarely straight), plumose (sometimes unilateral), hairs in lower part (3.3)4.5–5.8(7) mm long. Anthers (2.5)4.0–5.6(6.6) mm long, glabrous or with scattered hairs at the apex, yellow or purple. Ovary glabrous, styles two. Caryopsis (4.3)5.1–7.1(9.0) mm long, fusiform; embryo (1.2)1.5–2.0(2.7) mm long.

1a. Stipa caucasica subsp. caucasica

Stipa orientalis var. *grandiflora* Rupr., Mém. Acad. Imp. Sci. Saint-Pétersbourg, Sér. 7, 14(4): 35. 1869. *Type:* KYRGYZSTAN. In regione sylvatica jugi Tian-Shan, 20.vii.1867, *Osten-Sacken s.n.* (lectotype: designated here LE!).

Stipa caucasica f. *autumnalis* Roshev. in B.P. Fedtschenko (ed.), Fl. Aziat. Ross. 12: 142. 1916. *Type:* KAZAKHSTAN. Prov. Semirichinsk, Distr. Djarkinsk. Kapkak river, 13.vii.1912, *Saposhnikow & Schischkin s.n.* (lectotype: designated here LE!).

Stipa caucasica f. *brevifolia* Roshev. in B.P. Fedtschenko (ed.), Fl. Aziat. Ross. 12: 142. 1916. *Type:* UZBEKISTAN. Prov. Fergana, Distr. Margelan. Kitchik-Alay valley river, at 1–2 km of Kindik mouth, 13.v.1914, *Desiatoff 2186* (lectotype: designated here LE!) [39°46′N, 72°13′E].

Stipa caucasica f. *crassifolia* Roshev. in B.P. Fedtschenko (ed.), Fl. Aziat. Ross. 12: 142. 1916. *Type* KAZAKHSTAN. Prov. Semirechinsk, Distr. Djarkinsk, Ketmen village, 5.vii.1912, *Saposhnikow & Schischkin s.n.* (lectotype: designated here LE!).

Stipa caucasica f. *robusta* Roshev. in B.P. Fedtschenko (ed.), Fl. Aziat. Ross. 12: 143. 1916. *Type* KAZAKHSTAN. Prov. Syr-Darya, district Auliye-Ata. Around Aleksandrovskaia village, 16.v.1909, *Minkwitz 142* (lectotype: designated here LE!) [42°56′N, 75°30′E].

Stipa caucasica var. *major* Drobow, Repert. Spec. Nov. Regni Veg. 21: 37. 1925. *Syntypes:* UZBEKISTAN. Fergana. Alau, fl. Karamuk et circa lac. Kurban-kul, 1913, *Dolenko s.n.*; UZBEKISTAN. Distr. Andishan. Fl. Arslan-bob, 1899, *Litvinow s.n.* (unknown).

Stipa caucasica var. *typica* Drobow, Repert. Spec. Nov. Regni Veg. 21: 37. 1925. nom. inval. [ICBN, Art. 24.3].

Stipa tzvelevii Ikonn., Opred. Vyssh. Rast. Badakhshana: 84. 1979. *Type:* TAJIKISTAN. In valle fluvial Kischty, Dsharob supra pagum Langar, 10.vii.1956, *Ladygina s.n.* (holotype: LE!).

Stipa barchanica Lomon. in I.M. Krasnoborov, Fl. Sibir. 2: 224. 1990. *Type:* RUSSIA. Region Tuvaensis, lacus Teri-Chol Erzin, 29.vi.1947, *Sobolevskaja s.n.* (holotype: NS digital image!).

Plant 16–66 cm tall. Basal leaves 11–43 cm long; blade (0.36)0.47–0.72(0.89) mm in diameter, abaxial surface usually glabrous, adaxial surface minutely pubescent, papillose and more rarely pubescent, hairs

(0.02)0.07–0.12(0.55) mm long. Glumes (2.8)3.5–4.5(6.1) cm long. Anthecium (9.6)10.1–12.3(13.2) mm long; lemma (6.8)7.6–10.0(11.9) cm long, [ratio callus length/lemma length = (0.16)0.17–0.40(0.41)], lemma with seven lines of hairs that rarely reach the top, hairs (0.61)0.94–1.15(1.43) mm long, usually erect; coronula (0.4)0.6–1.2(1.5) mm long; callus (1.6)2.1–2.7(2.8) mm long, villous, dorsal hairs straight and shorter than the ventral hairs. Awn (7.0)8.2–10.9(13.4) cm long, column (1.6)1.8–2.9(3.2) cm long with hairs (0.4)0.6–1.0(1.77) mm long at the base (Figs 1N–R, 5A, B).

Additional illustration: Norlindh (1949: 65, fig. 5b); Goloskokov (1969: 69, table 7, fig. 2); Cui (1996: 301, figs 6–11).

Chromosome number: $2n = 44$ (Freitag, 1985; Sheidai, *et al*., 2006).

Habitat and distribution: Inhabits desert steppes, sandy to gravelly desert, slopes with rocks and pebbles, and woodland communities from lowlands to upper mountain belts. From the Caucasus, through northern Iran, Kopet Dagh (Turkmenistan), north Afghanistan and north Pakistan. In Central Asia, it can occur in the Turkestan region, the Pamir and the Alai Mountains up to the Tien Shan range and Altai-Dzungaria region. A few collections are from eastern Mongolia and from the lowlands of Tuva, Altai to Lake Baikal (Siberia); 400–4500 m (Fig. 2).

Phenology: Flowers and fruits from May to September.

Representative specimens examined: AFGHANISTAN. BADAKHSHAN: Pamir, Issiktal, 37°00′N, 73°19′E, 17.viii.1975, *Huss 206b* (MSB, W). BALKH: south Shadian, 36°31′N, 67°11′E, 2.viii.1958, *Pabot 1181* (G). GHOR: Kotl Cherzakh between Qala Chahrak (Sharak) and Chisht (Tschischt), 34°15′N, 64°10′E, 4.viii.1962, *Rechinger 19128* (G, LD, S). KABUL: Band-e-Amir, 34°25′N, 69°22′E, 28.vi.1958, *Pabot 1309* (G). LOWGAR: Lowgar, 33°50′N, 69°00′E, 29.vi.1951, *Volk 1726* (W). ORUZGAN: Kotale Gardesh, Daykundi village, 33°45′N, 66°15′E, 30.vii.1970, *Podlech 19063* (M); PAKTIA: Umgebung von Urgun, 32°54′N, 69°09′E, 30.v.1971, *Volk 71/212* (M). ARMENIA. GEGHARKUNIK: at Sevan lake close to Schordsha village, 40°30′N, 45°29′E, 27.vii.1929, *Smirnow 46* (B, G, JE, L, S). CHINA. XINJIANG: Pamir: distr. Yarkand, in Jersil valley, 38°23′N, 77°14′E, 14.vii.1930, *Persson 107* (S); southern Taxkorgan, above Dafda, 37°31′N, 75°27′E, 1.viii.1991, *Miehe* & *Miehe 5583* (GOET); south Tien Shan, at 10 km SE Baykurt, by the old road Turugart to Kashgar, 39°56′N, 75°32′E, 21.vi.1959, *Junatov 876* (NY). GEORGIA. TBILISI: west Tbilisi at Lisis lake, 41°44′N, 44°44′E, 24.v.1973, *Vašák s.n.* (M, W); close to Ateni, distr. Gorif, 41°55′N, 44°06′E, 25.v.1910, *Woronow 14* (W). IRAN. CHEHARMAHAL AND BAKHTIARI: between Kush-i-Dar and Dehgirdu, 32°00′N, 50°00′E, ix.1885, *Stapf s.n.* (WU). HAMADAN: Aq Bulaq 100 km N Hamadan, 35°36′N, 48°27′E, 15.v.–1.vii.1960, *Rioux & Golvan 75* (W). ISFAHAN: 103 km from Tehran, close to Dali-Tehoi, 33°55′N, 49°31′E, 11.vii.1960, *Pabot 4299* (G). KHORASAN: *c*. 8 km W Soolgerd, beginning of Nekarbandi valley, 37°29′N, 56°4′E, 30.v.1995, *Akhani 10555* (B); Torbat-e-Jam, mountain slopes and ravines at Bezg, 12 miles west of Torbat-e-Jam, 35°14′N, 60°51′E, 11.vii.1972, *Alava & Iranshahr 10961* (W). KHORASAN-E-JANUBI: between Bujnurd and Ghulaman, 36°18′N, 58°24′E, 8.vii.1956, *Schmid 6371* (G, W). MAZANDARAN: Col de Kandavan, 36°7′N, 51°17′E, 28.vii.1960, *Pabot 4887* (G). TEHRAN: Elburz Mountains: Kuh Dasteh mountain at 30 km W from Tehran, 35°40′N, 51°08′E, 28.vi.1977, *Rechinger 57303* (G). KAZAKHSTAN. ALMATY: Terskey Ala-tau, gorge of Baiynkol river at 24 km S of Tekes village, 42°50′N, 80°16′E, 26.vi.1950, *Medvedeva et al*. *133* (L); Reg. Semiretschensk: distr. Dzharkent, pr. stat. Sary-Dzhas, 42°54′N, 79°36′E, 27.vi.1910, *Michelson 1635 x* (L, LE, M, S, WU); Taldi-Kurgan close to Aina-Bulak spring, 44°36′N, 77°56′E, 10.vi.1928, *Pavlov 82* (G); SW Altai Djungarsk, Chulak mountain, gorge of Monna-Sai river, 43°57′N, 77°56′E, 29.v.1955, *Goloskokov s.n.* (GH). EAST KAZAKHSTAN: Semipalatinsk. Prov. Zaysanskiy. Distr. Tarbagatay, Oy-Kezen-Sartogoy, 47°30′N, 83°45′E, 1.vii.1914, *Saposchnikow & Genina s.n.* (LE); northern Altai Djungarsk. Kaykan mountains, NW Glinovki village, 46°00′N, 81°15′E, 18.vi.1959, *Goloskokov s.n.* (LE). QOSTANAY: Turgaisk Distr., Kizil-Dzhingil, lower reaches of Sary-su River, 49°51′N, 63°48′E, 30.v.1914, *Krascheninnikov 139* (W). SOUTH KAZAKHSTAN: Syr Darya. Aulie-Ata distr. Ichkele-Tash mountains, 42°25′N, 79°17′E, 16.v.1909, *Knorring 118* (L). KYRGYZSTAN: BISHKEK: Tien Shan, Kirgizski khrebet, 10 km NE Frunze (Pishpek), close to Chop-aryk village, 42°52′N, 74°36′E, 29.v.1974, *Vašak s.n.* (B). ISSYK-KUL: Taragay. Low part at the left of Karakoyun river, 41°10′N, 75°44′E, 30.viii.1964, *Trulebich* & *Kajennikova s.n.* (BR); Distr. Przhevsk. Inyl'chek at 10 km from the glacier 42°20′N, 80°05′E, 1.iv.1912, *Saposchnikow & Schischkin* (C). NARYN: Tien Shan. Kochkorskiy region, at 3 km west Tyulek village, 41°58′N, 75°41′E, 7.viii.1960, *Kurganskaia & Udintseva s.n.* (GDA, W). OŠ: Sufi Kurgan, Alai mountains, 40°02′N, 73°30′E, 18.vi.1898, *Paulsen 404* (C); Alai, at 15 km south of Iski-Naukatt village, 40°16′N, 72°36′E, 9.vi.1958, *Tzvelev 39* (K); RUSSIA: DAGESTAN. Distr. Temir-Ch. Schura. Close to Atly-bujun

Figure 1. *Stipa caucasica* subsp. *drobovii*: A, habit; B, floriferous culm node; C, ligule; D, spikelet; E, upper glume; F, lower glume; G, anthecium and column; H, column in detail (at 1 cm from the base of the column); I, lemma; J, palea; K, lemma apex (coronula); L, callus, ventral view; M, callus, lateral view. *Stipa caucasica* subsp. *caucasica*: N, spikelet; O, column in detail (at 1 cm from the base of the column); P, anthecium; Q, callus, ventral view; R, callus, lateral view. *Stipa caucasica* subsp. *glareosa*: S, spikelets; T, column in detail (at 1 cm from the base of the column); U, anthecium. [Based on: A–M, *Medvedeva* 21.v.1954 (LE); N–R, *Trulebich & Kajennikova* 30.viii.1964 (BR); S–U, *Tzvelev 850* (LE).]

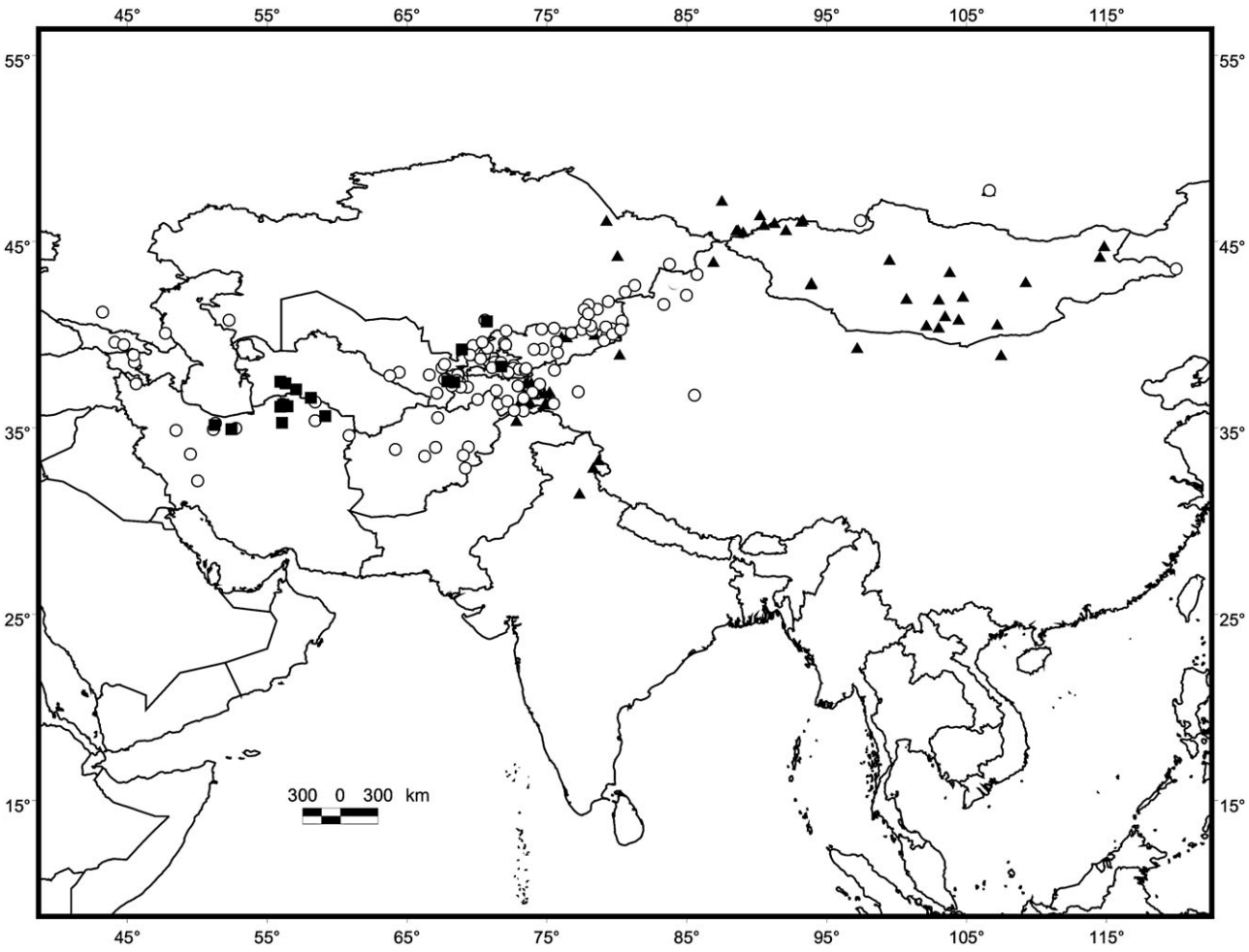

Figure 2. Distribution map: ○, *Stipa caucasica* subsp. *caucasica*; ▲, *S. caucasica* subsp. *glareosa*; ■, *S. caucasica* subsp. *drobovii*.

station, 42°33′N, 47°42′E, 12.v.1901, *Alexeenko s.n.* (S); IRKUTSK: Tazheranskaya steppe, along Lake Baikal at Bukhta Aya (AYA BAY); 158 km NE of mouth Angara, 52°47′N, 106°37′E, 30.vi.1979, *Iltis et al. 256* (NY, S, U); STAVROPOL: Sever-Ossetinskaja ASSR. Podkumok river valley, 44°04′N, 43°12′E, 24.vi.1914, *Gordjagin 3374b* (C, H, NY, S, W); Sever-Ossetinskaja ASSR. prope stationem Podkumok, 44°04′N, 43°12′E, 24.vi.1914, *Gordjagin 3374a* (C, H, NY, S, W). TURKMENISTAN: AHAL: Turcomania. Aschabad. Gaudan, 37°39′N, 58°24′E, 29.v.1898, *Litwinow 2174* (GH); Aschabad; Suluklü (Saratowka), 37°19′N, 37°14′E, 13.vii.1900, *no collector 882* (B, G, JE, LD, UPS, W, WU). TAJIKISTAN: GORNO-BADAKHSHAN: west Pamir (Bajan). 10 km E Lyangar village. Southern slope of Alichur range, 37°03′N, 72°40′E, 7.viii.1953, *Lavrenko, Stanjukovich & S. S. Ikonnikov s.n.* (LE). NW Pamir in declivitate lapidosa prope ostium fl. Tachta-Korum, 38°47′N, 72°55′E, 6.viii.1958, *Tolmatceva 4759* (C, JE, MA, S). Southern slope of Darvazskiy range, Dzhari-Dariga forest, 38°28′N, 71°21′E, 20.vii.1963, *Davliashov & Akulishiva 457* (LE); Chechekta, close to Por-Utech river mouth, 38°21′N, 73°58′E, 4.viii.1962, *S. S. Ikonnikov 14575* (LE). KHATLON: Shuroabad region, 37°50′N, 70°2′E, 26.viii.1935, *Linzevki & Maslennikova 1239* (LE). SUGHD: Gissarskiy range. Sart-Tag river mouth close to Iskander-Kul lake, 39°04′N, 68°21′E, 31.viii.1933, *Gordienko & Chilikina 453* (B); Buchara, prov. Hissár. Pyandzh-Khok, 39°03′N, 68°46′E, 8/20.viii.1896, *Lipskyi s.n.* (W); W Zeravshan range. NW spur Kun-Safe mountain, 39°19′N, 67°46′E, 7.vii.1932, *Ovczinnikov & Slobodov s.n.* (LE). UZBEKISTAN: FERGANA: Distr. Margelan. SW of the rocky slope of Katta-Karamuk valley river, 40°28′N, 71°43′E, 19.vi.1913, *Desiatoff 1251* (S); between Czigirczik and Guleza, 40°07′N, 71°04′E, 27.vi.1901, *Alexeenko s.n.* (M). SAMARKAND: Distr. Djizak. Turkestan. Between Kizil-Mazari & Kul-Say, 40°20′N, 67°40′E, 13.vi.1914, *Michelson. s.n.* (M, S, W);

Nobobad village, Jagnob river, 39°11′N, 68°32′E, 16(28).vii.1896, *Lipskyi s.n.* (W); SYRDARYO: Zeravshan-Gissar. Slopes of Farab-Sai ravine, 39°67′N, 67°28′E, 13.vi.1931, *S. A. Nikitin & Kulik 228* (NY). TASHKENT: Tien Shan. Alai range, Oš-Khorog road (179 km), 41°0′N, 69°29′E, 21.viii.1971, *S. S. Ikonnikov, Ladigina & Litvinova 8748* (LE); Tien Shan, montes Kuraminski khrebet, close to Kamchik village, 41°05′N, 70°31′E, 28.vii.1973, *Vasák s.n.* (B).

1b. Stipa caucasica subsp. glareosa (P.A.Smirn.) Tzvelev

Stipa caucasica subsp. *glareosa* (P.A.Smirn.) Tzvelev, Novosti Sist. Vyssh. Rast. 11: 20. 1974. *Stipa glareosa* P.A.Smirn., Repert. Spec. Nov. Regni Veg. 26: 266. 1929. *Type:* MONGOLIA. Changai, steppum glareosum in depressione lac. Orok-nor, 7.ix.1924, *Pavlov 169* (holotype: MW; isotype: LE!).

Stipa orientalis var. *trichoglossa* Hack., Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 55: 164. 1903. *Type:* KYRGYZSTAN. Ad Sufi Kurgan in montibus Alai, 18.vi.1898, *Paulsen 404* (lectotype: designated here C!; isolectotype: W!).

Stipa caucasica f. *desertorum* Roshev. in B.P. Fedtschenko (ed.), Fl. Aziat. Ross. 12: 143. 1916. *Stipa caucasica* var. *desertorum* (Roshev.) Tzvelev in V.I. Grubov, Pl. Central Asia 4: 53. 1968. *Stipa caucasica* subsp. *desertorum* (Roshev.) Tzvelev, Novosti Sist. Vyssh. Rast. 11: 20. 1974. *Stipa desertorum* (Roshev.) Ikonn, Opred. Vyssh. Rast. Badakhshana: 83. 1979. *Type:* KYRGYZSTAN. Tien Shan, distr. Przhevalsk, ad fl. Tamaczi pr. Pagum lacum Issyk-kul, in arenis, 19.vi.1907, *Roshevitz 574* (lectotype: LE!, designated by Tzvelev, 1974).

Stipa glareosa f. *pubescens* P.A.Smirn. ex Roshev in V.L. Komarov (ed.), Fl. URSS 2: 89. 1934. *Stipa glareosa* var. *pubescens* (P.A.Smirn. ex Roshev) Gubanov, Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol. 87(1): 124. 1982. *Type:* MONGOLIA. Gobi Altai. Bain-Tsagan, 4.viii.1931, *N. P. Ikonnikov-Galitzky & V. A. Ikonnikova-Galitzkaya 3824* (lectotype: LE, designated by Grubov, 1982).

Stipa glareosa var. *langshanica* Y.Z.Zhao, Acta Sci. Nat. Univ. Intramongol. 23(4): 546. 1992. *Stipa langshanica* (Y.Z.Zhao) Y.Z.Zhao, Acta Sci. Nat. Univ. Neimenggu. 27(2): 211. 1996. *Type:* CHINA. Langshan, 4.vi.1988, *Zhao Yizhi et al. 4077* (holotype: HIMC).

Plant 8–34 cm tall. Basal leaves 5–25 cm long; blade (0.25)0.33–0.42(0.47) mm in diameter, abaxial surface usually scabrous, adaxial surface papillose, minutely pubescent or pubescent, hairs (0.02)0.07–0.22(0.75) mm long. Glumes (1.8)2.1–2.3(2.6) cm long. Anthecium (7.4)7.5–8.9(9.6) mm long; lemma (5.3)5.7–6.6(7.1) mm long, [ratio callus length/lemma length = (0.29)0.3–0.4], lemma with seven rows of hairs that rarely reach the top, hairs (0.45)0.50–0.68(0.75) mm long, erect-spreading hairs; coronula (0.5)0.7–1.1(1.2) mm long; callus (1.7)1.9–2.2(2.7) mm long, villous, dorsal hairs straight and shorter than the ventral hairs. Awn (4.5)5.1–5.8(7.5) cm long, column (0.7)1.2–1.3(1.5) cm long with base hairs (0.5)0.9–1.4(1.7) mm long (Figs 1S–U, 5C, D).

Additional illustration: Tzvelev (1968: 275, pl. II, fig. 4); Cui (1996: 298, figs 1–8); Wu & Raven (2007: fig. 269).

Chromosome number: $2n = 44$ (Freitag, 1985; Sheidai *et al.*, 2006).

Habitat and distribution: Stipa caucasica subsp. *glareosa* is more plentiful at high altitudes and is a more eastern taxon than subsp. *caucasica*. It inhabits gravelly or sandy desert steppes, sand washes, sandy, pebble or rocky slopes and borders of irrigated lands. It grows in lowlands, footslopes of mountains up to high mountain belts. It is found in eastern Pamir, Tien Shan range, Himalaya of northern India, northern Pakistan, central and western China (Gansu, Hebei, Henan, Nei Mongol, Ningxia, Qinghai, Shaanxi, Xinjiang, Tibet), Mongolia, Altai range, central and western Siberia; 1100–5500 m (Fig. 2).

Phenology: Flowers and fruits from May to August.

Representative specimens examined: CHINA. GANSU: Anxi Mazong Shan, 41°33′N, 97°10′E, 18.vi.1886, *Xu Lang Ren et al. s.n.* (M). TIBET: Tibet, *JJ. s.n.* (BR, G, L, S, U, UPS, W, MEL). XINJIANG: Pamir of China. Tashkurgan valley. West extreme of Tushkurgan mountain, 37°46′N, 75°13′E, 13.vi.1959, *Junatov & I-Fen 603* (GH); southern valley of Muji, 38°56′N, 74°28′E, 16.viii.1998, *Wündisch 1381* (GOET); central Tien Shan, Uchkuli river, 41°56′N, 79°4′E, 27.vii.1982, *Grubov s.n.* (LE). INDIA: JAMMU AND KASHMIR: Salt Lake Rupshu, 32°58′N, 78°17′E, viii.1913, *Stewart 442a* (W); Nima mud, Ladak, Kashmir, 33°30′N, 78°40′E, viii.1913, *Koelz, 2342a* (NY); Tibet. Prov. Ladák, locality: Káltse to Dámkar, 34°30′N, 78°42′E, 15–19.vii.1856, *no collector* (L). KAZAKHSTAN: EAST KAZAKHSTAN: Altai. Valley of Chegan-Uzuna river, 50°38′N, 79°15′E, 17.vii.1903, *Krylov s.n.* (H); In collibus lapidosis Songoriae ad rivulum Donjyk, 48°08′N, 80°03′E, 1841, *Karelin & Kiriloff s.n.* (H); Altai. Chegan-Uzuna river valley, 50°38′N, 79°15′E, 17.vii.1903, *Krylov s.n.* (H). KYRGYZSTAN. ISSYK-KUL: Reg. Semirechenskaya, distr. Przhewalskii, in vicinnis stat. Choktal (ad rip. septentr. lac. Issik-kul), 42°35′N, 76°44′E, 28.v.1910, *Michelson 51* (H); Tien Shan, Issyk-Kul-Gebiet, Issyk-Kul-See, Kara-Talaa, 42°18′N, 76°23′E, 30.vi.2002,

Dürbye 1684 (B). OŠ: Alpes Alexandri: Turduk in Kaschkara river valley, 41°45′N, 72°01′E, 7.vi.1896, *Brotherus 148* (H). MONGOLIA. ARKHANGAI: Khangai; in a barren steppe near the brook Nogon-Kovyr, 47°52′N, 99°28′E, 31.viii.1926, *Pavlov 125* (L, LE, NY, S). GOBI-ALTAI: Tonkhil somon, west bank of lake Tonkhil-Nur, 46°11′N, 93°54′E, 16.vii.1947, *Junatov 2769* (LE); Region Tonjim. At 6 km south of Tonjil-Nur lake by the road to Tamchi, 46°06′N, 93°53′E, 16.vii.1947, *Junatov 2737* (LE). ÖMNÖGOVI: south Gobi Khan-Bogdo district, at 1 km SE of the old rail station, at the tail of Galba range, 43°12′N, 107°12′E, 24.ix.1940, *Junatov s.n.* (LE); east Gobi. Erdeni region. Baraj-Tala, at 15 km north Jashiat-Jud, 43°00′N, 103°00′E, 24.ix.1940, *Junatov s.n.* (LE); Shabarakh Usu, Outer Mongolia, 45°00′N, 103°00′E, 1925, *Chaney 80* (LE, NY). RUSSIA. ALTAI: Kosch-Agatsch Steppum Tschuense, 49°59′N, 88°40′E, 15.vii.1968, *Ogurejeva s.n.* (B, H, JE, S, W). IRKUTSK: Baykal, Oviurskiy region, at 17 km Ubsu-Nur lake, close to Ak-Chira village, NE Amdaiguin-Joli lake, 50°42′N, 93°18′E, 7.viii.1973, *Timojina & Djukov 1714* (LE); near Aya Bay, 52°47′N, 106°36′E, vi.1979, *Elias & Smirnow 90* (NY). TUVA: Bay-Tayga district, Teli city, 51°02′N, 90°14′E, 27.vii.1947, *Sobolevskaia s.n.* (C); Mongun-Taigin region, Kargi river valley, at 5 km from Mugur-Aksy, Tsagan-Shibet range, 50°21′N, 90°30′E, 26.vii.1981, *Lomonosova & Vershinin 2846* (LE); Chuyskaya steppe, 49°50′N, 89°0′E, 14.vii.1937, *Kalinina s.n.* (LE). TAJIKISTAN: GORNO-BADAKHSHAN: Pamir, Karakuli, Kara-Art valley, at 5 km from the rivers mouth, 39°03′N, 73°35′E, 28.viii.1962, *Ladigina & S. S. Ikonnikov 14797* (LE); Pamir. Chechekti. Middle part of the glacier, 38°20′N, 74°00′E, 6.ix.1951, *Steshenko s.n.* (LE); Pamir. Left side at the gorge of Ayujalu valley, 38°28′N, 74°15′E, 1.viii.1961, *Sidorov 68* (LE); Pamir. Turkestan. By Akbaytal river, 38°13′N, 74°2′E, 14.vii.1897, *Korshinsky 5642* (LE).

1c. Stipa caucasica subsp. drobovii Tzvelev

Stipa caucasica subsp. *drobovii* Tzvelev, Novosti Sist. Vyssh. Rast. 11: 20. 1974, nom. nov. *Stipa bella* Drobow, Repert. Spec. Nov. Regni Veg. 21: 37. 1925, nom. illeg., non Phil. 1870. *Stipa drobovii* (Tzvelev) Czerep., Sosud. Rast. SSSR: 387. 1981. *Type:* KAZAKHSTAN. Karatau ridges north of lake Biilikol, shaly slopes toward Lake Akkul, 1.vi.1922, *Drobow 285* (lectotype: LE!, designated by Tzvelev, 1976).

Stipa caucasica subsp. *iskanderkulica* Tzvelev, Novosti Sist. Vyssh. Rast. 11: 20. 1974. *Stipa iskanderkulica* (Tzvelev) Czerep., Sosud. Rast. SSSR: 387. 1981. *Type:* UZBEKISTAN. Samarkand, ad lacum Iskander-kul, 39°04′N, 68°21′E, 21.v.1914, *Dubjansky s.n.* (holotype: LE!).

Plant 11–45 cm tall. Basal leaves 5–19 cm long; blade (0.37)0.51–0.66(0.69) mm in diameter, abaxial surface usually glabrous, adaxial surface pubescent, hairs (0.1)0.27–0.37(0.60) mm long. Glumes (3.0)3.3–4.0(4.2) cm long. Anthecium (9.4)10.0–10.4(11.6) mm long; lemma (7.4)8.7–9.2(10.2) mm long, [ratio callus length/lemma length = (0.12)0.13–0.15(0.17)], lemma with seven rows of hairs that usually reach the top, spreading hairs; coronula (0.7)1.1–2.0(2.2) mm long; callus (1.07)1.20–1.34(1.57) mm long, villous, dorsal hairs falcate and longer than ventral hairs. Awn (5.9)6.9–8.1(8.7) cm long, column (1.6)1.7–2(2.3) cm long with base hairs (1.6)1.8–2.1(2.9) mm long (Figs 1A–M,
5E, F).

Chromosome number: Unknown.

Habitat and distribution: Inhabits desert or semi-desert steppes on calcareous clay and saline soils. It ranges from Azerbaijan through northern Iran to western Turkmenistan, eastern Tajikistan and Syr Darya province (Kazakhstan). Probably in western Kyrgyzstan (although most of the material was identified as *S. bella* from these territories, it was redetermined as subsp. *caucasica*) (Fig. 2).

Phenology: Flowers and fruits from May to August.

Representative specimens examined: AZERBAIJAN. DZHULFA: Nachrepublica prope pag Dzhulfa (Jolfa), 37°57′N, 58°06′E, 27.v.1932, *Keideman, s.n.* (WU). IRAN. GOLESTAN: Persia, N Gorgan (Mohammed Rez Shah National Park): in planitie ad viam versus Almeh ducentum, N. Robat-e Qareh Bil, 37°19′N, 56°26′E, 1975, *Rechinger 52843* (B, G, M, W). KHORASAN: N Seman; 4 km north of Bidak, along Derazi valley, 37°18′N, 55°54′E, 18.v.1995, *Akhani 10753* (B); NW Khorasan. W Soolgerd Guard station, 37°27′N, 56°08′E, 27.iv.1995, *Akhani 10511* (B); ca. 5 km W of Mirza-Baylu, 37°21′N, 56°12′E, 24.v.1995, *Akhani 10928* (B, M). KHORASAN E JANUBI: 70 km from Téhéran, close to Homand village, 35°41′N, 52°25′E, 11.vii.1960, *Pabot 4293* (G). RAZAVI KHORASAN: between Mashad and Quchan, 36°37′N, 59°07′E, 24.v.1959, *Merton 3950* (K, W). SEMNAN: Touran Protected area (SE of Shahrud), E side of Kuh-e-Yazdu pass at road Ghazazan-Ahmadabad, 36°09′N, 56°01′E, 8.v.1978, *Freitag 15176* (B). KAZAKHSTAN. SOUTH KAZAKHSTAN: Kyzyl Kum. Karakalpak, Bel-Kul mountains, 41°24′N, 68°55′E, 21.vii.1932, *Muravliansky s.n.* (LE). TAJIKISTAN. SUGHD: Zeravshan, Iskander lake, 39°04′N, 68°21′E, 2–4.vii.1882, *Regel s.n.* (LE); Iskander kul lake, 39°04′N, 68°21′E, 24.vi.1892, *Komarov* (LE); Marguzar lake, 39°08′N, 67°51′E, 1892, *Komarov s.n.* (LE). TURKMENISTAN.

AHAL: Prov. Aschabad, Transcaspia-Gebiet montes Kopet-Dagh, 37°57′N, 58°06′E, 16.v.1911, *Michelson s.n.* (WU). BALKAN: Kopet-Dag. At 16 km SW Kizil-Arvat, close to Djanajir village, 38°58′N, 56°16′E, 27.iv.1952, *Rodin et al. 3011* (LE); Kopet-Dag, footslope of Kelyat range, 38°33′N, 57°01′E, 21.v.1954, *Medvedeva s.n.* (LE); west Kopet-Dagh. At 15–20 km south Iskander village, 39°05′N, 55°55′E, 12.v.1986, *Leontiv 143* (LE). LEBAP: Saracoschan. Saratat, 39°32′N, 63°45′E, 16.vi.1870, *O. Fedtschenko s.n.* (W). UZBEKISTAN. FERGANA: Distr. Margelan. Between Vuadil and Okhna village, 40°10′N, 71°43′E, 21.v.1913, *Dessiatoff 610* (NY).

Notes: Stipa caucasica is the most widespread and commonly collected species of the section. Although this species is rather polymorphic, it exhibits some constant features that make it easily distinguishable from the other species of the section, such as the completely hairy awn with a falcate seta. Most similar in this respect and likewise in general habitat is *S. orientalis* Trin., which grows in the same area and often alongside *S. caucasica.* Indeed, they may be found together on the same sheet and their similarity has often led to misidentification. However, *S. orientalis* may be easily distinguished by its bigeniculate awn and its much longer ligules.

Throughout its geographical range, it is highly variable morphologically and numerous specific and infraspecific names have been applied to plants of this species. This variability is not only with regard to the spikelets and plant size, but also to the surface of its basal leaves. Tzvelev (1974, 1976) recognized five subspecies for *S. caucasica* based on awn and anthecium length and the basal leaf surface, which was reduced to two subspecies by Freitag (1985).

Stipa glareosa was initially described as an eastern vicariant of *S. caucasica*, growing at high altitudes in Mongolia, mostly distinguished by its scabrous basal leaves and the smaller size of various structures of the plant (Smirnow, 1929). New collections after 1929 greatly increased its known distribution area, but with many problems of identification in many zones because of the overall similarity of its spikelets to those of subsp. *caucasica*. As pointed out by Freitag (1985), the difference in size is obvious when comparing *S. glareosa* with plants of *S. caucasica* from lower altitudes; however, most of the morphological differences overlap when comparing *S. glareosa* and *S. caucasica* from higher altitudes. At higher altitudes and in harsher environmental conditions, these plants generally exhibit a smaller size, with correspondingly smaller spikelets. These two species have been historically differentiated by the abaxial surface of the basal leaves, but it seems to be a variable character in both taxa. *Stipa caucasica* subsp. *caucasica* usually has glabrous leaves, but minutely scabrous ones occur here and there. Specimens of *S. glareosa* also usually exhibit scabrous leaves, but almost glabrous ones are also found throughout its distribution range. Therefore, following the most recent floristic treatments (Tzvelev, 1976; Freitag, 1985; Wu & Phillips, 2006), we consider *S. glareosa* to be a subspecies of *S. caucasica*.

Stipa caucasica subsp. *desertorum* was initially described as a form of *S. caucasica*, densely tufted and with a small size of 5–18 cm (Roshevitz, 1916). Tzvelev (1976) also emphasized the glabrous abaxial surface of the basal leaves. However, S. caucasica subsp. (in cursive) *desertorum* is the same size as subsp. *glareosa* and, as commented above, specimens of subsp. *glareosa* with glabrous leaves are frequently found throughout its distribution area. Therefore, from our point of view, and following Freitag (1985), *S. caucasica* subsp. *desertorum* and subsp. *glareosa* represent the same taxon.

Stipa bella Drobow, legitimately published as *S. caucasica* subsp. *drobovii* (Tzvelev, 1974), requires more attention. Drobow (1925) based his description on specimens with a completely pilose lemma and somewhat longer hairs of the awn. Ovczinnikov (1957) also emphasized a denser pilosity and much longer hairs of the adaxial surface of the basal leaf, upheld by Tzvelev (1976). Although subsp. *drobovii* usually has the basal leaves with longer hairs than those of subsp. *caucasica* and *glareosa*, scattered populations of these last two subspecies may be found with long hairs, even longer than those of subsp. *drobovii*. However, after a careful examination of the collections, we noticed that several previously undocumented features related to the callus clearly segregate subsp. *drobovii* from the other two subspecies. Although subsp. *drobovii* has an anthecium of similar size to those of subsp. *caucasica*, it always has the shortest callus. Subspecies *drobovii* has the dorsal hairs of the callus falcate and longer than the ventral ones, whereas the remaining subspecies have straight hairs on both sides that are always shorter on the dorsal side.

Stipa caucasica subsp. *iskanderkulica* was initially described as a variety of *S. bella*, endemic to Gissar Darvaz and distinguished by its hairy basal leaves. After a careful examination of the material, we noticed that the hairs of the basal leaves become more scattered towards the apex, and finally disappear from the second half of the leaf. As this variation of the surface ornamentation is frequently found in other species of *Stipa* (e.g. *S. tianschanica*, *S. iberica* Martinovský, *S. arabica* Trin. & Rupr. and *S. lagascae* Roem. & Schult), this character is considered to be of low value for taxon delimitation. Apart from the leaf ornamentation, subsp. *iskanderkulica* shares the same callus features mentioned above for subsp. *drobovii* and, from our point of view, represents the same subspecies.

More recently, *S. tzelevii* and *S. barchanica* have been described from Tajikistan and Siberia (Tuva), respectively (Ikonnikov, 1979; Lomonosova, 2000). Both species have been diagnosed as close to subsp. *glareosa*; however, after seeing the types, there is considerable overlap in plant and spikelet size with subsp. *caucasica*, and therefore they are placed in synonymy with this subspecies.

2. Stipa mongolorum Tzvelev

Stipa mongolorum Tzvelev, Fl. Central Asia: 4: 57, 68. 1968. *Type:* MONGOLIA. Erdeni somon, Borocha-Tala region, south of Dzamyn-Ude, 10.vi.1941, *Junatov s.n.* (holotype: LE!; isotypes: LE!).

Herbs 13–29 cm tall, perennial, densely caespitose; branching intravaginal. Culms with two or three nodes, nodes pubescent, with an evident stripe of hairs above, violet; culm internode papillose or glabrous beneath the node, the remainder usually glabrous. Basal leaves 6–21 cm long, green or slightly glaucous; sheaths glabrous or minutely scabrous, ciliate, cilia (0.12)0.14–0.25(0.35) mm long; blades 3–11 cm long, (0.30)0.35–0.40(0.44) mm in diameter, convolute, abaxial surface glabrous (rarely scattered aculeate), adaxial surface minutely pubescent or pubescent, hairs (0.06)0.10–0.14(0.17) mm long; ligules 0.2–0.5(0.6) mm long, rounded, pilose, ciliate, cilia (0.18)0.26–0.46(0.61) mm long. Floriferous culm leaves 4–15 cm long; sheaths 2–10 cm long, glabrous (rarely scattered aculeate), margins glabrous; blades 0.6–5.6 cm long, (0.15)0.25–0.33(0.40) mm in diameter, abaxial surface glabrous, adaxial surface pubescent or minutely pubescent, hairs (0.05)0.08–0.12(0.19) mm long; ligules (0.3)0.6–1.0(1.5) mm long, rounded (rarely truncate, bifid or obtuse), pilose or scabrous, ciliate (rarely glabrous), cilia (0.15)0.21–0.42(1.21) mm long. Panicle (7)10–15(19) cm long, lax, exserted or partially enclosed by the upper leaf sheath, with (two) three or four nodes; basal internode (1.0)1.6–7.3(9.4) cm long, glabrous; branches (1.6)2.3–3.8(5.8) cm long, spreading or erect-spreading, setose, setae (0.15)0.16–0.32(0.47) mm long; basal nodes with two or three branches with one or two (three) spikelets each. Glumes subequal, lanceolate, acuminate, glabrous, rarely ciliate on the central nerves, cilia 0.13–0.14 mm long, green with margins and tip hyaline, lower glume 1.5–1.8(1.9) cm long and with three to five nerves, upper glume (1.4)1.5–1.7(1.9) cm long and with three to five (six) nerves. Anthecium (3.7)6.3–7.2(8.0) mm long, (0.42)0.56–0.68(0.87) mm wide, fusiform, slightly laterally compressed, coriaceous, green, pale or brown; lemma (1.9)4.6–5.2(5.8) mm long, near the apex glabrous, densely hairy throughout (eventually with a longitudinal dorsal row more densely marked) with apressed hairs (0.40)0.43–0.52(0.63) mm long; apex with scattered hairs (0.5)0.6–0.8(0.9) mm long; callus (1.4)1.7–2.0(2.3) mm long, acute, curved, villous, hairs (0.82)0.85–1.15(1.22) mm long on the ventral face and (0.55)0.59–0.69(0.78) mm long on the dorsal face, scar elliptic, peripheral ring (0.30)0.40–0.47(0.60) mm long, (0.11)0.12–0.14(0.16) mm wide [ratio width/length = (0.25)0.26–0.37(0.40)]; palea (4.3)4.6–5.1(5.8) mm long, lanceolate, membranous, margins and tip hyaline, dorsally two-nerved, glabrous, with a dorsal line of hairs ending close to the apex, pale; lodicules three, equal or subequal, acute, lanceolate or linear lanceolate, hyaline, glabrous, dorsal lodicules 0.88–1.44 mm long, ventral lodicule 0.82–1.44 mm long. Awn (4.4)5.7–6.8(7.7) cm long, unigeniculate; column (0.40)0.50–0.70(0.75) cm long, base (0.21)0.22–0.30(0.35) mm in diameter, twisted, pale, brown or green–brown, hairy, hairs at the base of the column (1.58)1.88–2.72(3.16) mm long, (2.19)2.25–2.79(3.32) mm long below the geniculation; seta (4.0)5.2–6.2(7.0) cm long, [ratio column length/seta length = 0.07–0.08(0.12)], straight, plumose, hairs in lower part (2.34)2.61–3.87(4.28) mm long. Anthers 2.34–3.97 mm long, glabrous (rarely with scattered hairs at the apex), yellow. Ovary glabrous, styles two. Caryopsis 4.47.4.73 mm long, fusiform; embryo 1.09–1.15 mm long (Figs 3, 5G, H).

Additional illustrations: Tzvelev (1968: 275, pl. II, fig. 3); Wu & Raven (2007: 268, figs 6–10).

Chromosome number: Unknown.

Habitat and distribution: Inhabits arid steppes, rocky slopes, mud cone trails, sands and pebbles, from lowlands to low mountain belts. Endemic to Mongolia and north China; 800–1300 m (Fig. 4).

Phenology: Flowers and fruits from June to August.

Representative specimens examined: MONGOLIA. DORNOGOBI: Erdeni region, Borokha-Tala region. South Dzamyn-Ude, 44°20′N, 111°14′E, 16.vi.1941, *Junatov 3130* (LE); east Gobi: Ulan Baderkhu somon, west rim of Borokha-Tala, 43°47′N, 109°49′E, 17.vi.1941, *Junatov 370* (LE); east Gobi. Urgen-Tsetserlik Region. Sain-Utu baun at 40 km northwest Sain-Shanda, 45°16′N, 110°8′E, 28.viii.1940, *Junatov s.n.* (LE); Tel'ulan Shanda region 16 km north-east of Sain-Shanda, 44°53′N, 110°8′E, 31.viii.1940, *Junatov s.n.* (LE); east Gobi, at 10 km south of Uje-Djargalant, 45°4′N, 109°0′E, 15.vii.1971, *Isachenk* & *Rachkovskai s.n.* (LE); central Gobi. Undur-Shili Region, at 30 km southwest of Undur-Shili, 45°15′N, 108°17′E, 2.vi.1941, *Junatov s.n.* (LE). DUNDGOBI: Delger Hangay somon; 8–10 km NW extremity of Delger-Hangay mountain range along old road from Ulan

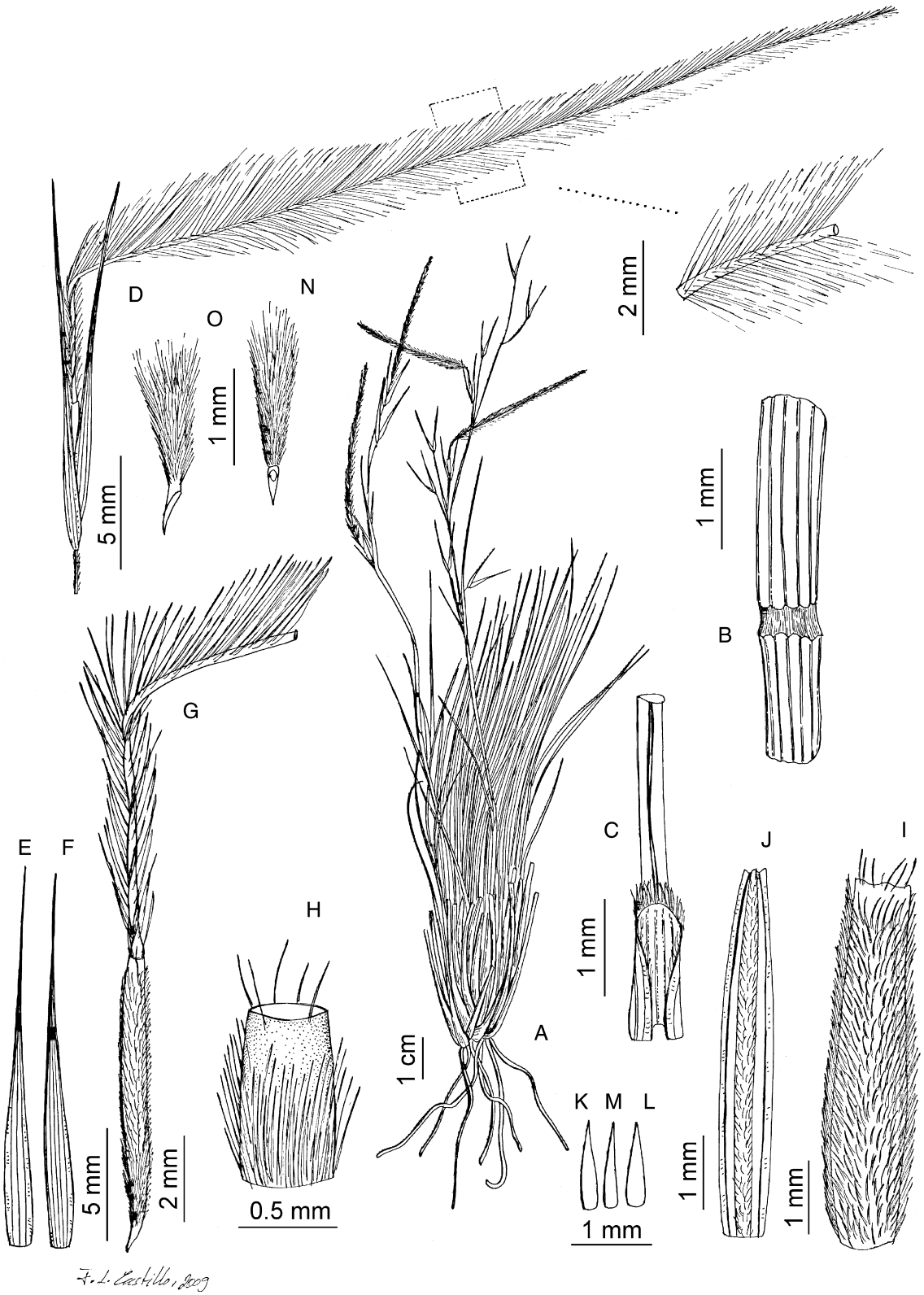

Figure 3. *Stipa mongolorum*: A, habit; B, floriferous culm node; C, ligule; D, spikelet; E, upper glume; F, lower glume; G, anthecium and column; H, lemma apex; I, lemma; J, palea; K, L, dorsal lodicules; M, ventral lodicule; N, callus, ventral view; O, callus, lateral view. [Based on: *Junatov 368* (LE).]

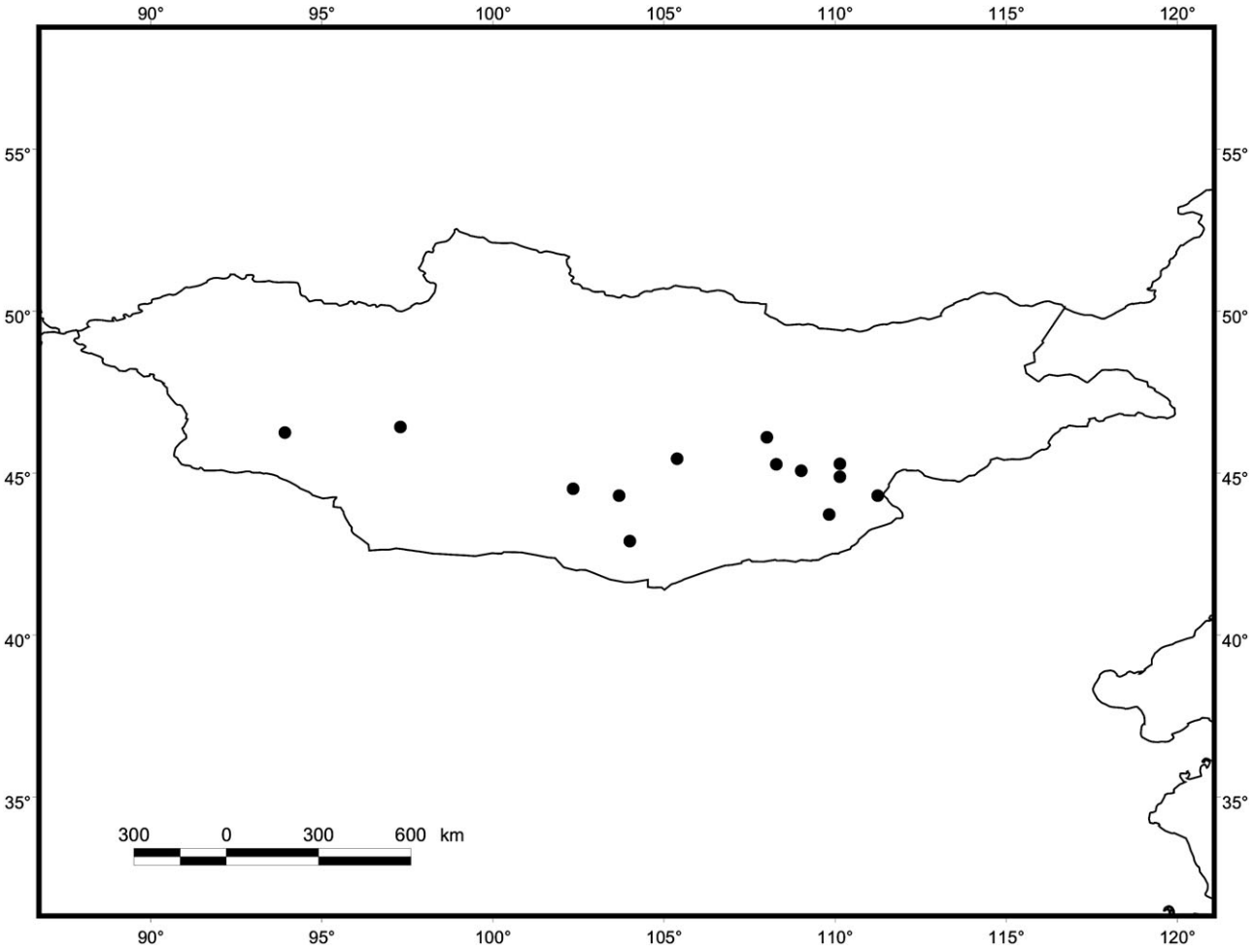

Figure 4. Distribution map of *Stipa mongolorum* (●).

Bator to Dalan Dzadagad, 45°25′N, 104°83′E, 17.vii.1943, *Junatov s.n.* (LE). GOBI-ALTAI: Tonkhil somon, west bank of Tonkhil-Nur lake, 46°11′N, 93°54′E, 16.vii.1947, *Junatov 2773* (LE); left bank of Dzaijina river by Taishiri & Delger road. At 38 km of Taishiri, Tairim plain, 46°21′N, 97°17′E, 24.viii.1972, *Grubov, Ulziijutag*, *Dolgotkov* & *Tsetsegmaia 1179* (LE). ÖMNÖGOBI: Uburjangai. At 25 km WSW Teg mine by Bogd road, 44°32′N, 102°20′E, 25.vi.1972, *Banzrach et al. s.n.* (LE); Shabarakh Usu, Outer Mongolia, 43°00′N, 104°00′E, 1925, *Chaney 80* (GH, NY, W).

Notes: Stipa mongolorum differs from the other species of the section by having a loose panicle with long and spreading branches, small spikelets, short seta hairs and a completely hairy lemma. *Stipa mongolorum* resembles *S. caucasica* subsp. *glareosa*. Both taxa share similar area and habitats (Tzvelev, 1968), and are frequently found on the same sheet. Indeed, their resemblance has led to misidentifications across their contact areas. *Stipa mongolorum* can also be distinguished from *S. caucasica* subsp. *glareosa* by its shorter glumes and by having the column 8–10 times shorter than the seta, whereas *S. caucasica* subsp. *glareosa* has longer glumes and the column is three to five times shorter than the seta.

Stipa monoglorum was initially described as an endemic species from Mongolia, but it has recently been reported from Nei Mongol and Ningxia (Helan Shan) in China (Wu & Phillips, 2006). Unfortunately, no material from China has been available for this revision.

3. Stipa aktauensis Roshev.

Stipa aktauensis Roshev., Izv. Bot. Sada Akad. Nauk S.S.S.R. 30: 302. 1932. *Type:* UZBEKISTAN. Prov. Syr-Darya. Aktau, between Turkestan and Petro-Aleksandrovsk, 6.v.1916, *Filatov 219* (holotype: LE!).

Stipa lingua var. *minor* Roshev. in B.P. Fedtschenko (ed.), Fl. Aziat. Ross. 12: 146. 1916. *Type:* UZBEKI-

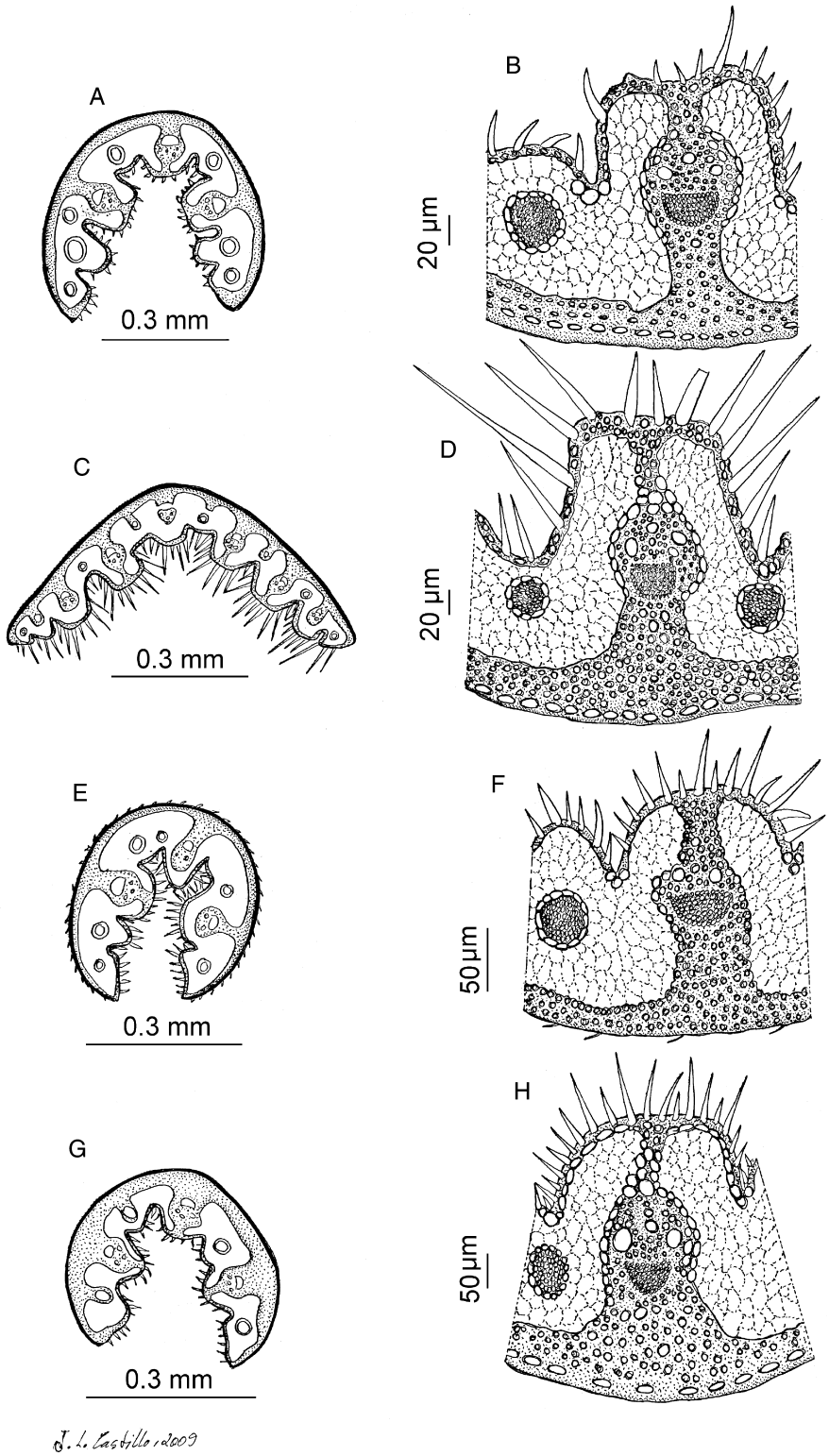

Figure 5. *Stipa caucasica* subsp. *caucasica*: A, transverse section of leaf blades; B, central nerve of leaf blades. *Stipa caucasica* subsp. *glareosa*: C, transverse section of leaf blades; D, central nerve of leaf blades. *Stipa caucasica* subsp. *drobovii*: E, transverse section of leaf blades; F, central nerve of leaf blades. *Stipa mongolorum*: G, transverse section of leaf blades; H, central nerve of leaf blades. [Based on: A, B, *Trulebich & Kajennikova* 30.viii.1964 (BR); C, D, *Tzvelev 850* (LE); E, F, *L. Medvedeva* 21.v.1954 (LE); G, H, *Junatov 368* (LE).]

STAN. Between Kayak-Ati and Adam-Kirulgan, 1873, *Korolkovym & Krauze s.n.* (holotype: LE!).

Herbs 16–36 cm tall, perennial, densely caespitose, branching intravaginal. Culms with three (two to four) nodes, nodes glabrous or rarely pubescent, brown or violet; culm internodes minutely pubescent or distinctly scabrous beneath the node, the remainder glabrous, papillose (rarely minutely pubescent). Basal leaves 8–22 cm long, green; sheaths glabrous or minutely scabrous, ciliate (rarely glabrous), cilia 0.2–0.43(0.51) mm long; blades 8–16 cm long, (0.44)0.54–0.71(0.77) mm in diameter, convolute or conduplicate, abaxial surface sparsely aculeate (sometimes glabrous at the lower half), adaxial surface pubescent or minutely pubescent, hairs (0.07)0.14–0.20(0.30) mm long; ligules up to 0.35 mm long, truncate or replaced by a line of hairs, densely ciliate, cilia (0.35)0.69–0.92(1.24) mm long. Floriferous culm leaves 8–21 cm long; sheaths 4–19 cm long, upper sheaths sometimes swollen, glabrous, papillose or minutely scabrous, margins glabrous; blades 1–7 cm long, (0.12)0.31–0.50(0.73) mm in diameter, abaxial surface glabrous or scattered aculeate, adaxial surface minutely pubescent or pubescent, hairs (0.07)0.12–0.22(0.30) mm long; ligules (0.2)0.3–0.6(1.4) mm long, truncate, rounded or replaced by a line of hairs, surface pilose or minutely scabrous, ciliate, cilia (0.13)0.31–0.58(0.86) mm long. Panicle (7)8–11(19) cm long, contracted, enclosed or partially enclosed by the upper leaf sheath, with (three) four or five (six) nodes; basal internode (0.1)0.2–0.6(2.9) cm long, pilose, hairs (0.07)0.17–0.27(0.33) mm long; branches (1.4)1.6–3.2(3.9) cm long, erect or erect-spreading, setose, setae (0.26)0.27–0.4(0.45) mm long; basal nodes with two (one to three) branches, with one or two spikelets each. Glumes equal or subequal, lanceolate, acuminate, glabrous or rarely ciliate on the central nerve, cilia 0.90–0.13 mm long, green with margins and tip hyaline or entirely hyaline, lower glume (3.5)4.0–4.4(4.7) cm long and with three (five) nerves, upper glume (3.4)3.4–4.1(4.5) cm long and with three (five) nerves. Anthecium (9.9)10.0–11.2(11.5) mm long, (0.64)0.74–0.98(1.13) mm wide, fusiform, coriaceous, pale; lemma (8.0)8.1–9.4(9.5) mm long, with seven distinct or diffuse rows of erect-spreading hairs, the ventral one usually reaching the top or ending 0.2–1.0 mm below, the dorsal one reaching the top or ending 0.5–1.5 mm below, the remaining rows ± equalling dorsal row, hairs (0.4)1.0–1.5(1.9) mm long; coronula with hairs (0.96)1.39–2.21(3.09) mm long; callus (1.7)1.8–2.1(2.4) mm long, acute, curved, villous (sometimes the dorsal face villous only above the scar and glabrous below the lemma), hairs (1.00)1.07–1.65(1.82) mm long on the ventral face and (0.20)0.33–0.50(0.60) mm long on the dorsal face, scar ± elliptic, peripheral ring (0.66)0.77–0.86(1.00) mm long, (0.24)0.25–0.29(0.30) mm wide (ratio width/length = 0.30–0.38); palea (7.9)8.2–9.1(9.6) mm long, lanceolate, membranous,margins and tip hyaline, dorsally two-nerved, glabrous, rarely with a dorsal line of hairs up to one-half to two-thirds the length of the palea, pale; lodicules three, equal or subequal, lanceolate or linear-lanceolate acute, hyaline, glabrous, dorsal lodicules (1.50)1.58–2.00(2.20) mm long, ventral lodicule (1.60)1.83–2.45(3.40) mm long. Awn (10.8)11.7–14.5(15.4) cm long, unigeniculate; column (0.9)1.4–1.6(1.7) cm long, base (0.24)0.33–0.43(0.44) mm in diameter, twisted, pale or green and brown, hairy, hairs at the base of the column (1.65)1.93–2.38(2.65) mm long, (2.59)3.03–3.45(3.94) mm long below the geniculation; seta (9.9)10.4–13(13.7) cm long [ratio column length/seta length = (0.09)0.1–0.14], straight, plumose with hairs in lower part (3.2)4.5–5.5(6.3) mm long. Anthers (2.9)3.4–5.1 mm long, glabrous or with scattered hairs at the apex, yellow or purple. Ovary glabrous, styles two. Caryopsis (6.02)7.00–7.50(8.10) mm long, fusiform; embryo (1.50)2.18–2.60(2.70) mm long (Figs 6, 10A, B).

Chromosome number: $2n = 44$ (Sokolovskaya & Probatova, 1978).

Habitat and distribution: Inhabits footslopes of mountains up to low mountain ranges, on rocky basic and sandy slopes. Its distribution is restricted to the Kyzyl Kum desert (Uzbekistan). However, it could probably be found on the southern Kazakhstan boundary with Uzbekistan (Goloskokov, 1969); 300–1000 m (Fig. 7).

Phenology: Flowers and fruits from April to July.

Representative specimens examined: UZBEKISTAN. BUXORO VILOYATI: SE Kyzyl Kum desert. Between Jdangueldi spring and Taidaras. Kul'dzhuktau mountain, 40°45′N, 63°50′E, 21.v.1937, *Bochantsev 536* (LE); Buchara. Singruntau mountain, 40°45′N, 63°50′E, 11.vi.1948, *Negaeva s.n.* (LE). NAVOIY VILOYATI: sands of SW Kyzyl Kum. Bukan-tau city, Araslai forest zone, 42°36′N, 63°28′E, 8.vi.1932, *S. A. Nikitin & Mikhailova s.n.* (LE); Middle Asia, Kyzyl Kum desert. Aktau mountains, 41°40′N, 64°28′E, 3.vi.1932, *Muralvljansky 82* (B, FI, G, H, JE, L, LE, W); central Kyzyl Kum, Altau Tamdinskiy, 42°00′N, 65°00′E, 24.iv.1972, *Kamelin et al. 472* (LE); Samarkand Mountains, Sangrun-Tau, 41°15′N, 65°10′E, 10.vi.1948, *Nekaeva 385* (LE); central Kizyl-kum, Bukan-Tau, Irlir mountain next to Irlir spring, 42°33′N, 63°24′E, 26.iv.1977, *Kamelin et al. 607* (LE); Kyzyl Kum desert. Aristan-tau mountain, 41°17′N, 64°46′E, 5.vii.1970, *Bochantsev 31* (LE). QARSHQADARYO VILOYATI: SE Kyzyl Kum desert.

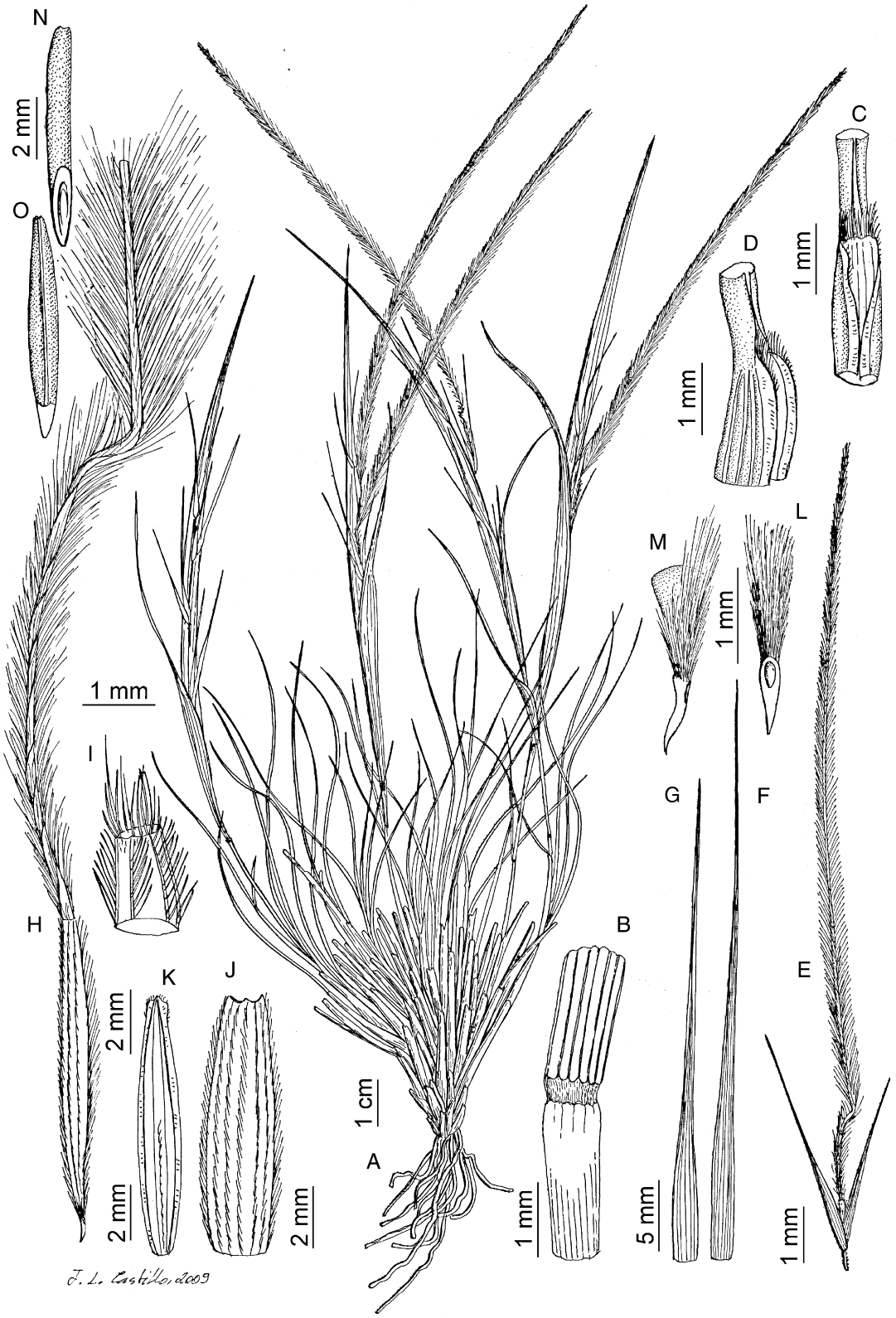

Figure 6. *Stipa aktauensis*: A, habit; B, floriferous culm node; C, ligule, frontal view; D, ligule, lateral view; E, spikelet; F, upper glume; G, lower glume; H, anthecium and column; I, lemma apex (coronula); J, lemma; K, palea; L, callus, ventral view; M, callus, lateral view; N, caryopsis, dorsal view; O, caryopsis, ventral view. [Based on: *Muravljansky 82* (H).]

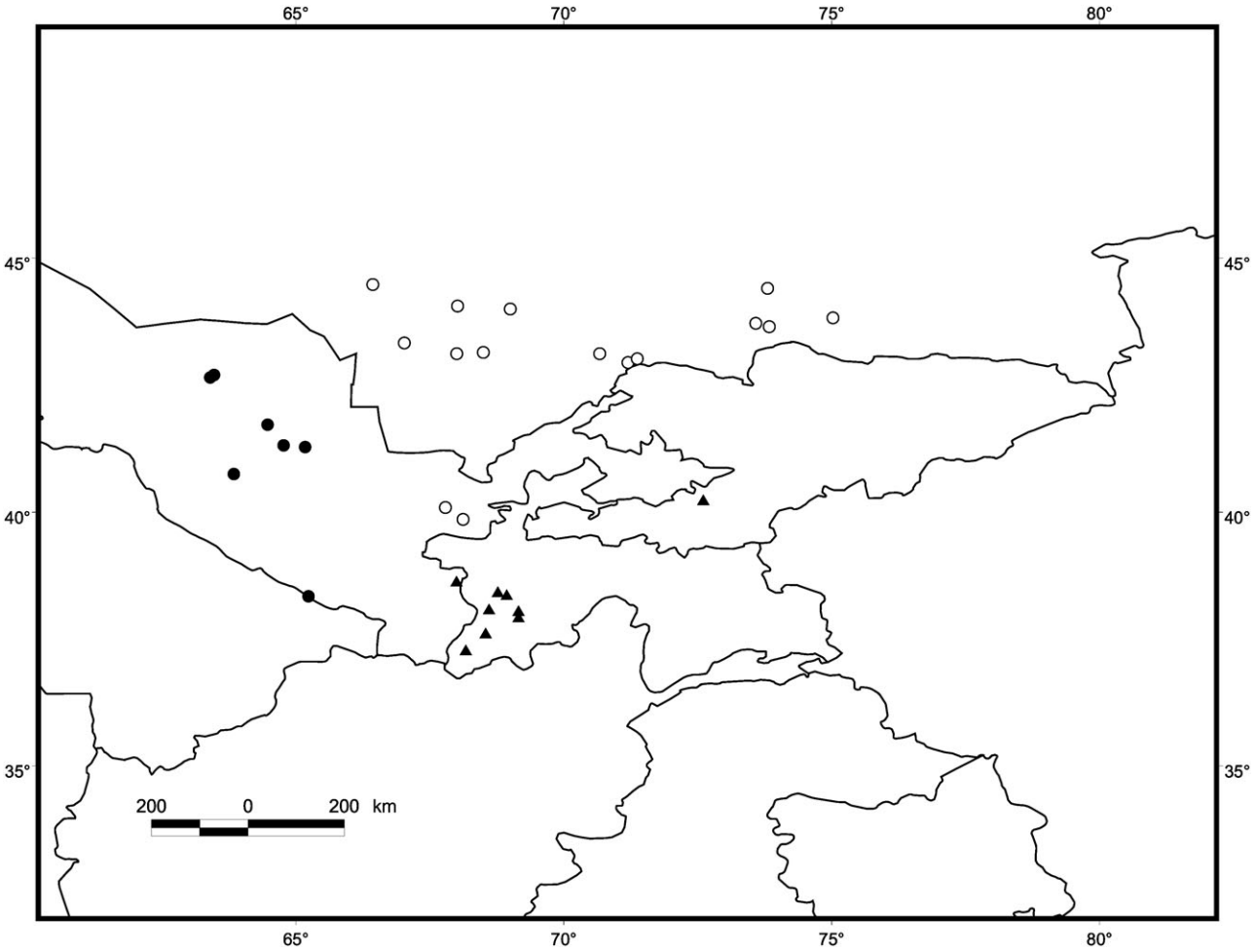

Figure 7. Distribution map: ●, *Stipa aktauensis*; ○, *S. karataviensis*; ▲, *S. longiplumosa*.

Surroundings Aiak-Kudjumda mountain, 38°28′N, 65°14′E, 12.v.1937, *Bochantsev 351* (LE).

Notes: Stipa aktauensis is quite similar to *S. lingua*, especially in the awn shape. Roshevitz (1916) initially described it as a variety of *S. lingua*, differing in the smaller size of the spikelet. Roshevitz (1932) recognized it as an independent species, and placed it with *S. lingua* in series *Brevigeniculatae*. *Stipa aktauensis* can be easily distinguished from *S. lingua* by the smaller size of the anthecium, glumes and awn, and the shorter hairs of the seta, as pointed out by Roshevitz (1916). In addition, in *S. lingua*, the abaxial surface of the basal leaves is glabrous and the callus is foot-like expanded, whereas, in *S. aktauensis*, the abaxial surface is scabrous or scattered aculeate, and the callus is not foot-like expanded.

Stipa aktauensis, *S. lingua* and *S. caucasica* share a completely hairy awn, which distinguishes these three species from the remainder of the species of section *Smirnovia*. Moreover, *S. caucasica* spikelets are quite similar in size to those of *S. aktauensis*, and the two are usually placed together in keys to *Stipa* spp. (Pazij, 1968; Tzvelev, 1976). Although both species share a hairy awn, the awn shape clearly distinguishes them. *Stipa akatauensis* has the column one-seventh to one-eleventh of the length of the awn and a straight seta, whereas *S. caucasica* has the column one-half to one-sixth of the length of the awn and a falcate seta.

4. Stipa lingua A.Junge

Stipa lingua A.Junge, Izv. Imp. S.-Peterburgsk. Bot. Sada. 10: 129. 1910. *Type:* TURKMENISTAN. Prope Germab, 30.v.1889, *Antonov s.n.* (holotype: LE!).

Herbs 9–68 cm tall, perennial, loosely to densely caespitose; branching intravaginal. Culms (two) three or four noded, nodes pubescent or glabrous, violet or pale; culm internode pubescent, glabrous (rarely scabrous). Basal leaves 4–38 cm long, green; sheaths minutely pubescent or glabrous, ciliate, cilia (0.17)0.38–0.85(1.79) mm long; blades 4–37 cm long,

(0.43)0.58–0.76(1.18) mm in diameter, usually convolute, abaxial surface glabrous (rarely minutely scabrous or sparsely aculeate at the base), adaxial surface pubescent or minutely pubescent, hairs (0.04)0.20–0.40(0.60) mm long; ligules replaced by a line of hairs (0.32)0.54–1.39(3.48) mm long. Fliferous culm leaves 8.5–38.4 cm long; sheaths 5–28 cm long, swollen or not, scabrous, papillose, glabrous (sometimes sparsely pilose), margins ciliate or glabrous; blades 0.5–13.0 cm long, (0.08)0.37–0.61(1.3) mm in diameter or 2.47–4.00 mm wide, abaxial surface glabrous, adaxial face pubescent or minutely pubescent, hairs (0.05)0.10–0.23(0.54) mm long; ligules (0.1)0.3–0.6(1.4) mm long, truncate or replaced by a line of hairs, pilose, ciliate, cilia (0.2)0.4–0.8(3.7) mm long. Panicle (4)8–25(46) cm long, contracted, enclosed, exserted or partially enclosed by the upper leaf sheath, with (two) three to six (seven) nodes; basal internode (0.1)0.8–18.5(22.5) cm long or without basal internode, pubescent, scabrous, scattered pilose or scattered aculeate; branches (0.3)1.4–3.7(20.0) cm long, erect or erect-spreading, setose, setae (0.1)0.3–1.3(2.5) mm long; basal nodes with two (one to three) branches with one or two (three) spikelets each. Glumes subequal, lanceolate, long acuminate, glabrous, rarely ciliate on the central nerves, cilia (0.10)0.20–0.61(0.99) mm long, green or pale with margins and tip hyaline, the lower (5.2)6.6–8(9.1) cm long and three- to five-nerved, the upper (4.8)6.1–7.5(8.8) cm long and (3)5(7)-nerved. Anthecium (12.1)13.1–14.3(16.0) mm long, (0.70)0.96–1.25(1.90) mm wide, fusiform, coriaceous, pale, brown or green; lemma (10.4)11.3–12.4(13.2) mm long, near the apex glabrous or papillose, with seven distinct rows of spreading or erect-spreading hairs, the ventral row reaching the top or ending (0.2)0.8–1.3(2.7) mm below, the dorsal one measuring one-half or two-thirds of the length of the lemma, the remaining rows ± equalling the dorsal row, hairs (0.7)1.1–1.5(2.2) mm long; coronula (rarely with scattered hairs), hairs (0.3)1.1–2.3(3.3) mm long; callus (1.50)1.75–2.17(2.78) mm long, acute, curved, near the base foot-like expanded, totally villous (rarely glabrous) or with the ventral face villous close to the lemma and the dorsal face glabrous, hairs (0.8)1.1–1.7(2.3) mm long on the ventral face and (0.65)0.70–1.00(1.35) mm long on the dorsal face, scar circular, peripheral ring (0.80)0.94–1.11(1.20) mm long, (0.36)0.51–0.58(0.74) mm wide [ratio width/length = (0.36)0.45–0.62(0.85)]; palea (9.4)11.2–12.3(14.0) mm long, lanceolate, membranous,margins and tip hyaline, dorsally two-nerved (rarely three- or four-nerved, with the laterals one to one-half the length of the palea), papillose, or papillose between the nerves and the remainder glabrous, margins glabrous and tip glabrous or ciliate, pale, green; lodicules three, equal or subequal, with the ventral ones slightly longer or shorter than the dorsal one, acute, lanceolate or linear-lanceolate, hyaline, glabrous (rarely cilate at the apex), dorsal lodicules (1.57)2.11–3.00(3.64) mm long, ventral lodicule (1.80)2.55–3.07(3.73) mm long. Awn (13.3)16.9–23.0(28.5) cm long, unigeniculate; column (1.4)2.1–2.5(3.2) cm long, base (0.43)0.52–0.67(0.80) mm in diameter, twisted, pale brown, brown or green and brown, occasionally with purple stains, pilose, glabrous or tuberculate, hairs at the base of the column (0.8)1.7–2.5(3.7) mm long, (2.50)4.15–6.56(7.66) mm long below the geniculation; seta (11.1)14.4–20.6(26.0) cm long, [ratio column length/seta length = (0.08)0.09–0.2(0.24)], straight, plumose, hairs in lower part (5.87)7.56–9.51(12.03) mm long. Anthers (4.6)5.2–7.9(9.1) mm long, glabrous, yellow. Ovary glabrous, styles two. Caryopsis (8.23)8.77–9.71(10.95) mm long, fusiform; embryo (1.54)2.17–3.06(3.65) mm long.

4a. Stipa lingua subsp. lingua

Stipa lingua f. *brevifolia* Roshev. in B.P. Fedtschenko (ed.), Fl. Az. Ross. 12: 146. 1916. *Type:* TAJIKISTAN. Schugnan. Šachdary valley. Between Drum Dar river and Čay-Kil river, 26.vi.1914, *Tuturin* & *Bessedin 371* (lectotype: LE! designated here).

Stipa ovczinnikovii Roshev. in V.L. Komarov (ed.), Fl. URSS 2: 87. 1934. *Type:* TAJIKISTAN. Zeravshan close to Syuzhena village, 3.vi.1932, *Ovczinnikov 144* (holotype: LE!).

Stipa platypoda Bor, Biol. Skr. 14(4): 81. 1965. *Type*: AFGHANISTAN. Herat, *Aitchison 1137* (holotype: K!; isotype: BM!).

Plant 9–67 cm tall. Culms with three or four nodes; culm internodes pubescent, glabrous and more rarely sparsely pilose. Basal leaf 4–29 cm long; blade (0.4)0.5–0.7(0.9) mm in diameter, abaxial surface usually glabrous, adaxial surface pubescent or minutely pubescent, hairs (0.10)0.21–0.27(0.43) mm long. Upper cauline leaf sheaths usually swollen. Panicle 4–34 cm long, enclosed, partially enclosed or exserted; branches setose, setae (0.2)0.3–0.4(1.3) mm long. Anthecium (12.1)12.5–14.0(14.8) mm long; callus (1.6)1.7–2.0(2.3) mm long, glabrous or only the ventral surface villous (rarely completely villous). Awn (13.9)16.7–19.7(24.4) cm long; column (1.4)1.9–2.4(3.2) cm long, pilose; seta (11.5)13.5–17.4(22.5) cm long, plumose with hairs (7.6)8.9–10.5(12.0) mm long (Figs 8A–N, 10C, D).

Chromosome number: $2n = 44$ (Czopanov & Yurtsev, 1976; Freitag, 1985; Sheidai *et al*., 2006).

Habitat and distribution: Inhabits semiarid steppes on rocky and rubble slopes, sands and clays; characteristic of *Stipa* steppes from middle to high mountain belts. It ranges from the Turkmenistan mountains,

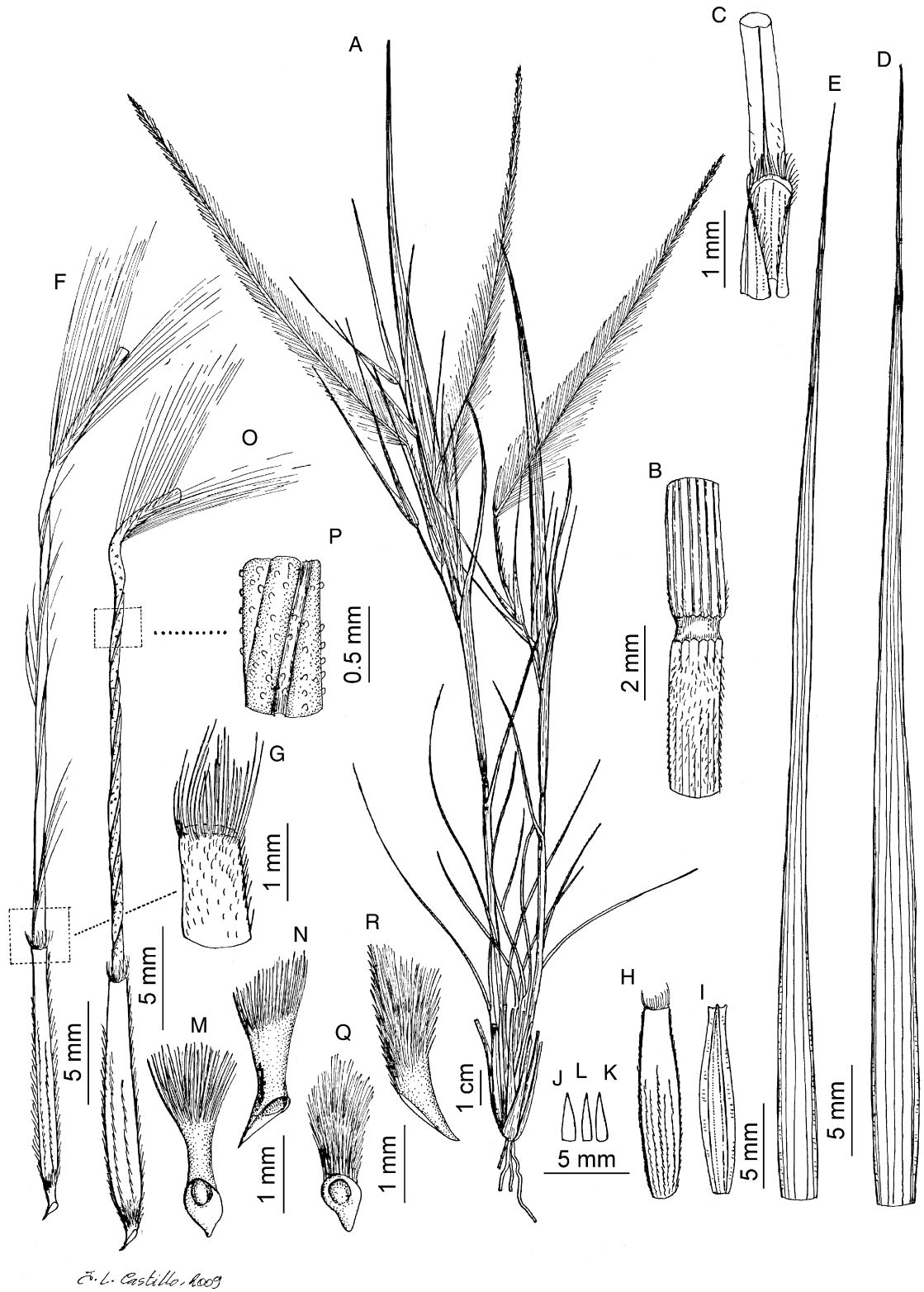

Figure 8. *Stipa lingua* subsp. *lingua*: A, habit; B, floriferous culm node; C, ligule; D, upper glume; E, lower glume; F, anthecium and column; G, lemma apex (coronula); H, lemma; I, palea; J, K, dorsal lodicules; L, ventral lodicule; M, callus, ventral view; N, callus, lateral view. *Stipa lingua* subsp. *lipskyi*: O, anthecium and column; P, column in detail (at 1 cm from the base of the column); Q, callus, ventral view; R, callus, lateral view. [Based on: A–N, *Podlech 31631* (M); O–R, *Ovczinnikov 144* [a] (LE).]

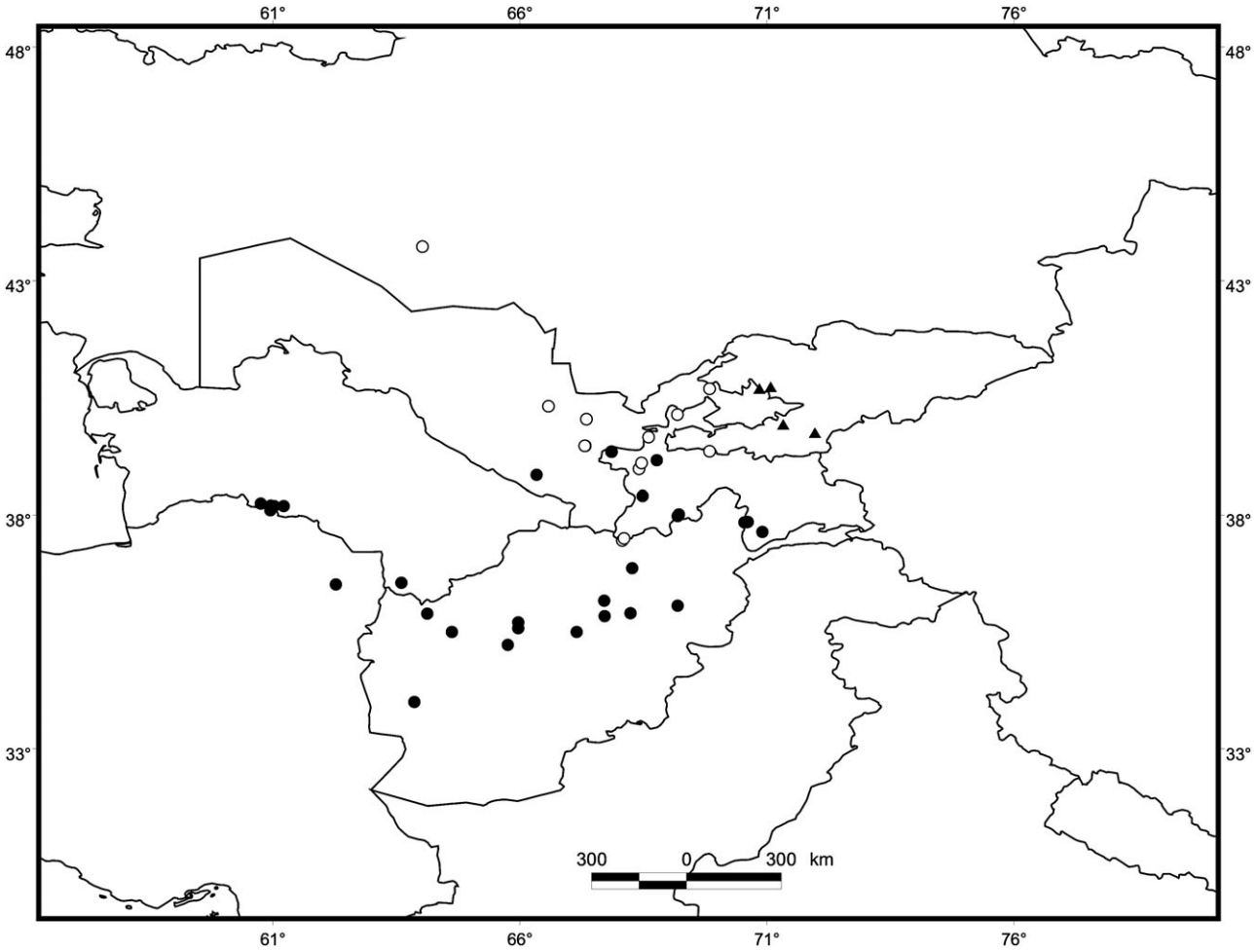

Figure 9. Distribution map: ●, *Stipa lingua* subsp. *lingua*; ○, *S. lingua* subsp. *lipskyi*; ▲, *S. lingua* subsp. *magnifica*.

through northern Iran and Afghanistan to southwestern Pamir; 1000–3200 m (Fig. 9).

Phenology: Flowers and fruits from May to August.

Representative specimens examined: Afghanistan. BAMYAN: top of Shibar pass, 34°22′N, 66°43′E, 28.vii.1958, *Pabot 1110* (G). GHORAT: Dolaini, Darreh, between Qala Chahrak (Sharak) and Naourak, 34°00′N, 64°45′E, 27.vii.1962, *Rechinger 18898* (G, W); Hari-rud valley, 34°28′N, 65°03′E, *Aitchinson 1137* (C, G, K, UPS, WU). HERAT: Wardar, 34°53′N, 62°28′E, x.1952, *Volk 1281* (B); Chashma-i-Obeh, 10 km NW Obeh, 34°22′N, 63°10′E, v.1977, *Unger 117* (MSB). PARVAN: Bergh Çange, W of Kandi, 35°07′N, 69°36′E, 23.vii.1973, *Anders 10834* (G); the highest of Ghorband valley, below Shibar pass, 34°54′N, 68°15′E, 28.vii.1965, *Podlech 12051* (K, M). SAMANGAN: 2 km W of Kotal-e-Mirza Atbili, 36°11′N, 68°18′E, 9.vi.1978, *Podlech 31631* (G, M); Elepasti, foothill of Band-e-Yakh, Djawzari valley, 35°15′N, 67°30′E, 9.vii.1976, *Rodenburg 233* (L). IRAN. HERAT: Herat and Farah, 1.vii.1949, 32°22′N, 62°06′E, *Gilli 413* (W). RAZAVI KHORASAN. Between Meshhed and Fariman, 35°43′N, 59°52′E, 4.vii.1937, *Rechinger 1357* (S, W). TAJIKISTAN. GORNO-BADAKHSHAN. West Pamir. Low part of Šachdary river. Southwest slope of Schugnan range, 37°30′N, 71°35′E, 13.vii.1964, *Grubov, Kurbambekov* & *Yunysov s.n.* (LE); low part of Šachdary river, the valley of Sadbargo river on the right side of Chandym affluent, 37°13′N, 72°00′E, 1914, *Tuturin* & *Bessedin 379* (LE); west Pamir. Dasht-Baranov, close to Khorog, 37°29′N, 71°31′E, 12.vii.1948, *Lavrenko & Rodin 945* (LE). SUGHD: Zeravshan range in the plateau of high mountains close to Kitut river mouth, 39°15′N, 69°0′E, 7.vi.1932, *Ovczinnikov* & *Slobodov s.n.* (LE). TURKMENISTAN. Ahal: central Kopet-Dagh mountains, Prov. Geok-Tepinskiy, between Čuli y Časkon, 37°58′N, 58°01′E, 29.v.1958, *Czopanov, s.n.* (LD, K, JE, G, GH, COI, W); Aschabad, Kopet-Dagh mountains, Vannovskiy, 37°57′N, 58°06′E, 16.v.1911, *Mich-*

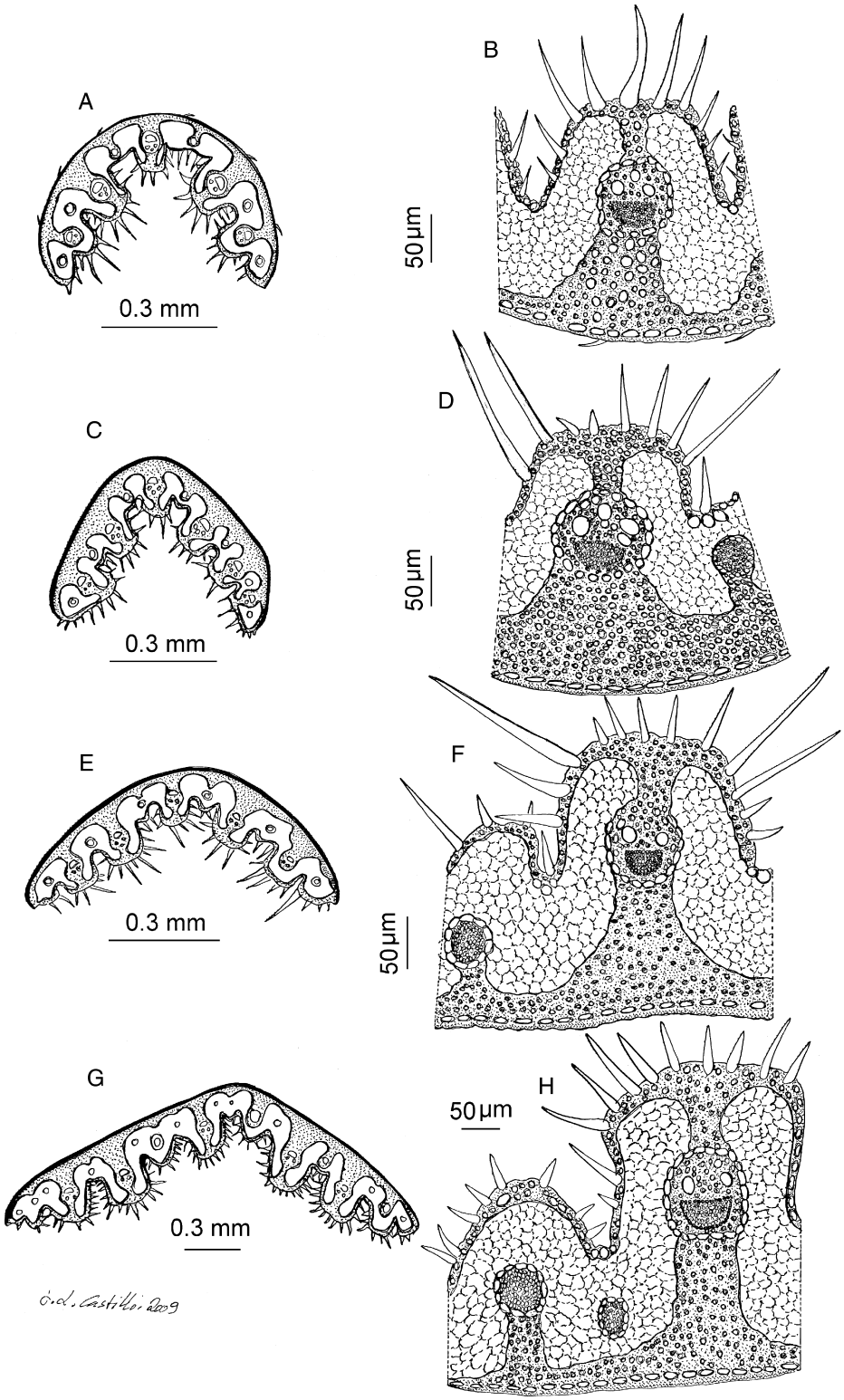

Figure 10. *Stipa aktauensis*: A, transverse section of leaf blades; B, central nerve of leaf blade. *Stipa lingua* subsp. *lingua*: C, transverse section of leaf blades; D, central nerve of leaf blades. *Stipa lingua* subsp. *lipskyii*: E, transverse section of leaf blades; F, central nerve of leaf blades. *Stipa lingua* subsp. *magnifica*: G, transverse section of leaf blades; H, central nerve of leaf blades. [Based on: A, B, *Muravljansky 82* (H); C, D, *Podlech 31631* (M); E, F, *Ovczinnikov 144* [a] (LE); G, H, *Lazikov* 4.v.2005 (LE).]

elson 234 (S, G, W, WU); Transcaspia Gebiet, Kopet-Dagh mountains, 37°50′N, 58°00′E, 17.v.1911, *Michelson 319* (WU, M); Prov. Zakaspiyskiy. Čuli close to Aschabad, 37°57′N, 58°23′E, 9.vii.1911, *Seidmuradova s.n.* (LE); MARY: Badkhyz region. Bodkhyzskiy Zapovednik wildlife reserve. Kepelja, 35°46′N, 61°44′E, 22.vii.1972, *Gorelova 3* (LE). UZBEKISTÁN. QASHQADARYO: Oy-Badak-Sai deep valley. Southern slope of Turkestan range. At 3–4 km of Kodshar village, 38°50′N, 65°35′E, 27.vi.1948, *Czestnaja 48* (LE).

4b. Stipa lingua subsp. lipskyi (Roshev.) R.Gonzalo

Stipa lingua subsp. *lipskyi* (Roshev.) R.Gonzalo, Ann. Bot. Fenn. 48:159. 2011.

Stipa lipskyi Roshev. in B.P. Fedtschenko (ed.), Fl. Aziat. Ross. 12: 153. 1916. *Type:* UZBEKISTAN. Samarkand district, Samarkand, 27.v.1897, *Lipsky 4530* (lectotype: LE!, designated by Tzvelev, 1976; isolectotype: MW).

Plant 14–43 cm tall. Culms with two or three (four) nodes; culm internodes pubescent. Basal leaf 11–21 cm long; blade (0.56)0.57–0.67(0.70) mm in diameter, abaxial surface usually glabrous, adaxial surface pubescent, hairs (0.33)0.41–0.55(0.60) mm long. Upper cauline leaf sheaths slightly swollen or nonswollen. Panicle 6.2–31.8 cm long, enclosed, partially enclosed or exerted; branches setose, setae (0.1)0.3–0.8(1.1) mm long. Anthecium (12.3)13.0–14.0(14.5) mm long; callus (1.5)1.7–2.1(2.2) mm long, villous. Awn (13.3)15.9–17.3(18.4) cm long; column (2.0)2.15–2.4(2.6) cm long, glabrous or tuberculate; seta (11.1)13.6–15.1(16.2) cm long, plumose, hairs (5.9)6.4–8.0(8.2) mm long (Figs 8O–R, 10E, F).

Chromosome number: Unknown.

Habitat and distribution: Inhabits semiarid steppes on rocky to aleurite slopes, from lowlands to middle mountain belts. Kyrgyzian steppes, through the Kyzyl Kum desert and western Tien Shan range to southern Tajikistan; 300–2600 m (Fig. 9).

Phenology: Flowers and fruits from May to August.

Representative specimens examined: KAZAKHSTAN. ZHAMBYL. Tien Shan occid. Montes Karatau, 43°05′N, 70°25′E, 23.v.–8.vi.1936, *Mikeschin 93* (B, FI, G, H, J, L, LE, S, W); Prov. Turgaiskaya: Kizil-dzhingilskaya distr., lower reaches of Sary-su River, 8–10 km NW of Tayljak-Kul lake, 45°20′N, 66°20′E, 18.v.1914, *Kraschenninikov 5003* (LE). TAJIKISTAN. KHATLON: Koyki-Tau mountains at NW of Ljublikar village, 37°2′N, 68°4′E, 18.v.1960, *Nepli s.n.* (LE); Koyki-Tau mountain at NW of Ayvadzh village, 36°58′N, 68°01′E, 17.v.1960, *Bochantsev* & *Egorova 17* (LE). REGION OF REPUBLICAN SUBORDINATION: Zeravshan pass, 39°30′N, 70°30′E, 3.vi.1932, *Ovczinnikov & Slobodov s.n.* (LE); Zeravshan pass, north slope of Gissarskiy pass, 39°0′N, 68°30′E, 6.vii.1948, *Kozlova 355* (LE). UZBEKISTAN. BUCHARA: Nura-Tau range at south of Djizlok pass, 40°25′N, 67°00′E, 26.v.1964, *Priajin s.n.* (LE); NAVOIY. North Aktau pass. Ingichke village at 23 km east of Nurata hill, 40°47′N, 65°55′E, 26.vi.1971, *Bochantsev* & *Kamelin 483* (LE). SAMARKAND: River Siab valley, close to Samarkand, 39°39′N, 66°58′E, 6.v.1913, *Michelson 1983* (K); Samarkand district, Samarkand, 39°39′N, 66°57′E, 29.v.1897, *Lipskyi s.n.* (W).

4c. Stipa lingua subsp. magnifica (A.Junge) R.Gonzalo

Stipa lingua subsp. *magnifica* (A.Junge) R.Gonzalo, Ann. Bot. Fenn. 48:160. 2011.

Stipa magnifica A.Junge, Izv. Imp. S.-Peterburgsk. Bot. Sada. 10: 128, table IV. 1910. *Type:* KYRGYZSTAN. Fergana province, Oš district, close to Gulcza, vi.1900, *Transchel s.n.* (holotype: LE!; isotypes: LE!, MW).

Stipa barbata var. *platyphylla* Hack., Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 55: 163. 1903. *Type:* KYRGYZSTAN. Alai Mts, Sufi Kurgan, 18.vi.1898, *Paulsen 407* (holotype: C!).

Plant 30–68 cm tall. Culms with three or four nodes; culm internodes glabrous. Basal leaves 10–36 cm long; blade (0.6)0.7–1.0(1.2) mm in diameter, abaxial surface usually glabrous, adaxial surface pubescent or minutely pubescent, hairs (0.04)0.10–0.15(0.21) mm long. Upper cauline leaf sheaths not swollen. Panicle 17–46 cm long, enclosed or partially enclosed; branches pilose, hairs (1.00)1.10–2.25(2.55) mm long. Anthecium (13.7)13.9–15.4(16.0) mm long; callus (1.5)1.8–2.6(2.8) mm long, villous. Awn (21.4)23.0–24.8(28.5) cm long; column (2.1)2.3–2.5(2.6) cm long, pilose; seta (19)21–22(26) cm long, plumose, hairs (7.0)8.0–8.9(10.5) mm long (Fig. 10G, H).

Chromosome number: Unknown.

Habitat and distribution: Inhabits rocky or clay slopes and semiarid steppes, from lowlands to middle mountain belts of Alai ranges in Kyrgyzstan; 600–2400 m (Fig. 9).

Phenology: Flowers and fruits from May to August.

Representative specimens examined: KYRGYZSTAN. JALAL-ABAD: Čatkalskiy range, Bozbu-Too mountain close to Djuk-Beli pass, 41°30′N, 70°45′E, 17.v.2005, *Lazikov s.n.* (LE); OŠ: Sari-Kamysh-Sau gorge close to Tash-Kumyr mountain, 41°20′N, 72°12′E, 4.v.2005,

Lazikov s.n. (LE); Fergana: in Gulera river valley, Sufi-Kurgan, 40°02′N, 73°30′E, 28.vi.1901, *Alexeenko 1422* (LE); Altai range at 15 km south from Oš city to Iski-Naukat village, 40°16′N, 72°36′E, 9.vi.1958, *Tzvelev 7* (LE).

Notes: Stipa lingua is one of the most widespread species of the section. It is mainly characterized by the combination of a long awn with a straight seta and somewhat short column, and the expanded callus base.

Stipa ovczinnikovii Roshev. was originally distinguished from *S. lingua* (1932) by its shorter floret (12–13 mm vs. 14–16 mm) and the equal plumosity of the awn. Tzvelev (1976) supported its specific rank and suggested its possible hybrid origin from *S. lingua* and *S. longiplumosa*. However, Pazij (1968) and Freitag (1985) listed it in synonymy with *S. lingua*. A careful examination of the material supports the latter view, as most of the studied specimens of *S. lingua* share identical features with *S. ovczinnikovii* in the sense of its original description.

Stipa lipskyi is closely related to *S. lingua*, from which it has been distinguished by its glabrous or tuberculate awn (Roshevitz, 1932). Beyond the column surface, both species are quite similar. Tzvelev (1976) was aware of this similarity, and suggested the possibility of combining *S. lipskyi* under *S. lingua* as a subspecies.

The distinctiveness of the vegetative features and the distribution of subsp. *magnifica* have also resulted in its recognition in all the floristic works as a different species. The treatment at species level has been based on the exserted panicle from the unswollen upper sheath of this taxon, whereas the panicle is enclosed by the swollen upper sheaths in subsp. *lingua* (Junge, 1910). This view was upheld by Pazij (1968) and by Tzvelev (1976), who considered its longer awn, anthecium and the completely villous callus as additional features to accept the species rank. After thorough examination of herbarium material, we noticed that several specimens of subsp. *lingua* from Turkmenistan and Afghanistan have longer panicles exserted from the unswollen upper cauline leaves (*S. caucasica* may exhibit indistinctly swollen or unswollen upper sheaths), whereas others show a completely villous callus. In addition to this, it was difficult to find a discrete difference between the size of the spikelets of subsp. *magnifica* and those of specimens of subsp. *lingua* from Afghanistan and Turkmenistan. This makes the diagnostic reliability of these characters doubtful. We also noticed two vegetative features not documented previously for subsp. *magnifica*: the longer hairs of the panicle branches and the absence of hairs below the culm nodes. Likewise, they have different geographical distributions, with subsp. *magnifica* occurring in the Alai Mountains of Kyrgyzstan, from where no specimens of subsp. *lingua* have been reported. In spite of the morphological and chorological differences, there is clear overlap between the range of variation of the characters traditionally used for taxonomy and, for this reason, *S. magnifica* is treated here as a subspecies of *S. lingua*.

5. Stipa karataviensis Roshev

Stipa karataviensis Roshev., Trudy Pochv.-Bot. Eksped. Izsl. Kolon. Rainov Aziatsk. Rossii, Chast' 2, Bot. Izsl. 6: 186. 1909. *Type:* KAZAKHSTAN. Syr Darya district, Aulie-Atinskii post, Karatau, upper part of the slope of one of the peaks in Berkka ravine, 23.v.1909, *Minkwits 310* (holotype: LE!).

Herbs 9–36 cm tall, perennial, loosely caespitose; branching intravaginal. Culms with five (three to six) nodes, nodes glabrous, violet; culm internode minutely pubescent beneath the node, the remainder glabrous or scattered pilose. Basal leaves 6–21 cm long, green, eventually pruinose; sheaths glabrous, papillose, scabrous or minutely pubescent, ciliate, cilia 0.33–1.10 mm long; blades 6–21 cm long, (0.29)0.45–0.60(0.62) mm in diameter, convolute or involute, abaxial surface glabrous (rarely minutely scabrous or scattered aculeate at the lower half), adaxial surface minutely pubescent, hairs (0.10)0.11–0.15(0.20) mm long; ligules 0.1(0.3) mm long, truncate or replaced by a line of hairs, ciliate with cilia (0.46)0.70–1.19(1.68) mm long. Floriferous culm leaves 5–18 cm long; sheaths 4–15 cm long, the upper sheath sometimes swollen, glabrous, margins glabrous or ciliate near the node; blades 0.36–6.2 cm long, (0.10)0.22–0.47(0.55) mm in diameter, abaxial surface glabrous, scattered aculeate, adaxial surface minutely pubescent or pubescent, hairs (0.07)0.09–0.14(0.18) mm long; ligules (0.2)0.4–0.8(1.3) mm long, truncate, obtuse or rounded, scabrous or pilose, ciliate, cilia (0.16)0.30–0.56(0.82) mm long. Panicle (3)7–11(14) cm long, contracted, enclosed or partially enclosed by the upper leaf sheath, with five (three to six) nodes; basal internode (0.1)0.2–0.7(4.6) cm long, glabrous or scabrous (rarely pilose); branches (1.2)1.9–2.9(5.8) cm long, spreading or erect-spreading, setose setae (0.21)0.25–0.60(0.69) mm long; basal nodes with one or two (to four) branches with one or two spikelets each. Glumes equal or subequal, lanceolate, acuminate, glabrous, green with margins and tip hyaline, the lower (2.7)3.1–3.5(3.7) cm long and with three to five nerves, the upper (2.7)2.9–3.4(3.6) cm long and with five (three to six) nerves. Anthecium (7.7)8.6–9.4(10.2) mm long, (0.68)0.79–0.93(0.97) mm wide, fusiform, slightly laterally compressed, coriaceous, pale or brown; lemma (6.8)7.6–8.6(9.0) mm long, near the apex papillose or minutely aculeate, surface with three or more, rarely five, distinct rows of erect-spreading hairs, the ventral

row ending 1.3–2.7 mm below the top, the dorsal one measuring one-third to one-half of the length of the lemma, hairs (1.42)1.50–2.15(2.24) mm long; apex glabrous or with scattered hairs (0.13)0.29–0.43(0.56) mm long; callus (0.82)0.88–1.00(1.16) mm long, acute, curved, near the base foot-like expanded, glabrous, scar circular, peripheral ring (0.50)0.54–0.62(0.68) mm long, (0.30)0.31–0.38(0.43) mm wide [ratio width/length = (0.52)0.54–0.71(0.78)]; palea (6.7)7.6–8.4(8.8) mm long, lanceolate, membranous, margins and tip hyaline, dorsally two-nerved, between the two nerves papillose, margins and tips glabrous or with tip ciliate, rarely with a dorsal line of hairs up to one-quarter to one-third the length of the palea, green or pale; lodicules three, equal or subequal, acute, lanceolate or linear-lanceolate, hyaline, glabrous, dorsal lodicules 1.01–1.92 mm long, ventral lodicule 1.11–2.29 mm long. Awn (7.4)8.2–10.5(11.0) cm long, unigeniculate; column (1.5)1.6–2.0(2.2) cm long, base (0.19)0.23–0.27(0.28) mm in diameter, twisted, pale brown, brown or green and brown, glabrous or glabrous at the base and tuberculate with scattered hairs below the geniculation; seta (5.9)6.5–8.7(9) cm long, [ratio column length/seta length = (0.18)0.21–0.26(0.27)], straight, plumose, hairs in lower part (4.46)4.72–5.81(6.51) mm long. Anthers (3.06)3.30–4.62(5.19) mm long, glabrous or with scaterred hairs at the apex, yellow. Ovary glabrous, styles two. Caryopsis (5.12)5.47–5.95(6.50) mm long, fusiform; embryo (1.50)2.00–2.20(2.23) mm long (Figs 11, 15A, B).

Additional illustrations: Goloskokov (1969: 69, table 7, fig. 3).

Chromosome number: Unknown.

Habitat and distribution: Inhabits rocky and limestone slopes of lower mountains. Its distribution roughly comprises western Tien Shan (south Kazakhstan), mainly occurring in the Karatau and Khantau ranges, and Chu-Iliyskie mountains. There are also isolated areas in the Naratau and Aktau mountains of Uzbekistan (Fig. 7).

Phenology: Flowers and fruits from May to July.

Representative specimens examined: KAZAKHSTAN. KYZYLORDA: Syr-Darya province. Perovskyi region. Balamurun forest zone, close to Karatau, on the slopes close to Čili, 44°17′N, 66°26′E, 19.v.1910, *Androsova 79* (LE). SOUTH KAZAKHSTAN: Syr-Darya province at Karatau mountains surroundings Ural-Tube, 43°00′N, 70°40′E, 26.v.1963, *Goloskokov s.n.* (LE); Tien Shan occid. Montes Karatau, 43°50′N, 69°E, 18–29.v.1930, *Lipschitz 92* (B, FI, G, H, JE, L, LE, S); Syr-Darya, Karatau mountains Bala-Saukandik in Koskuli (Jamankuli) lake zone, 43°1′N, 68°30′E, 13.v.1977, *Kamelin et al. 1394* (LE); Syr -Darya Karatau, southern slope of Uch-uzen gorge near place Kogashik, 43°53′N, 68°01′E, 11.v.1977, *Kamelin et al. 1255* (LE); Karatau Dschil, 43°50′N, 69°E, 1876, *Regel 493* (LE); Syr Darya Karatau, Kora-Uzen gorge at the upper reaches of the deep valley Boyaldyr, 43°33′N, 68°28′E, 9.v.1977, *Kamelin et al. 1137* (LE). ZHAMBYL: Syr-Darya Prov., Aulie-atinskii District, Berk-Kara gorge (Karatau), 42°54′N, 71°22′E, 23.v.1909, *Knorring 283* (LE); Syr-Darya Prov. Aulie-Atinskaya. Close to Golovachevki village, 42°50′N, 71°12′E, 25.v.1917, *Dingel s.n.* (LE); Karatau range. Region Turkestan. Ungurly, 43°30′N, 73°50′E, 6.vi.1935, *Tekutiev 171* (LE); Western Tien Shan. Kara-Tau moutains. Uzak-Uja forest, 43°34′N, 73°35′E, 21.vi.1934, *Pjataeva 336* (LE). UZBEKISTAN. SYR DARYO: Naratau. Tutak-Sai, 39°54′N, 68°07′E, 8.vi.1951, *Neustrueva, Knorring & Tsvetkova 208* (LE).

Notes: Stipa karataviensis is one of the easiest species in the genus to recognize. It may be distinguished from the other species of the section by its unmistakable three rows of hairs of the lemma instead of the seven rows or the completely hairy lemma of other species. Although *S. karataviensis* is, in general, morphologically rather uniform, in some specimens from Karatau (Syrdarinskaya Karatau, Kora-Uzen gorge at the upper reaches of the deep valley Boyaldyr, 9.v.1977, *Kamelin* & *al. 1137*; Syrdarinskaya Karatau, southern slope of Uch-uzen gorge near Kogashik, 11.v.1977, *Kamelin et al. 1255*) the lemmas show five rows of hairs with two short subdorsal rows.

Another feature that may assist in distinguishing *S. karataviensis* is the glabrous and foot-like expanded callus. Although these callus features are shared with *S. lingua* subsp. *lingua*, it is easily distinguished by the smaller size of its spikelets and by the character mentioned above.

6. Stipa tianschanica Roshev

Stipa tianschanica Roshev. in B.P. Fedtschenko (ed.), Fl. Aziat. Ross. 12: 149. 1916. *Type:* Prov. Semiretschje: distr. Prshewalsk, ad cursum inferiorum fl. Ak-Schiirjak in declivibus petrosis, 31 Jul 1913, *Schischkin s.n.* (holotype LE?; isotype, MW).

Herbs 10–45 cm tall, perennial, densely caespitose; branching intravaginal. Culms with two or three nodes, nodes glabrous or minutely scabrous, violet or pale; culm internode scabrous more rarely glabrous. Basal leaves 8–32 cm long, green or slightly glaucous; sheaths minutely pubescent, scabrous, papillose or glabrous, ciliate, cilia (0.15)0.32–0.50(1.10) mm long; blades 6–28 cm long, (0.34)0.41–

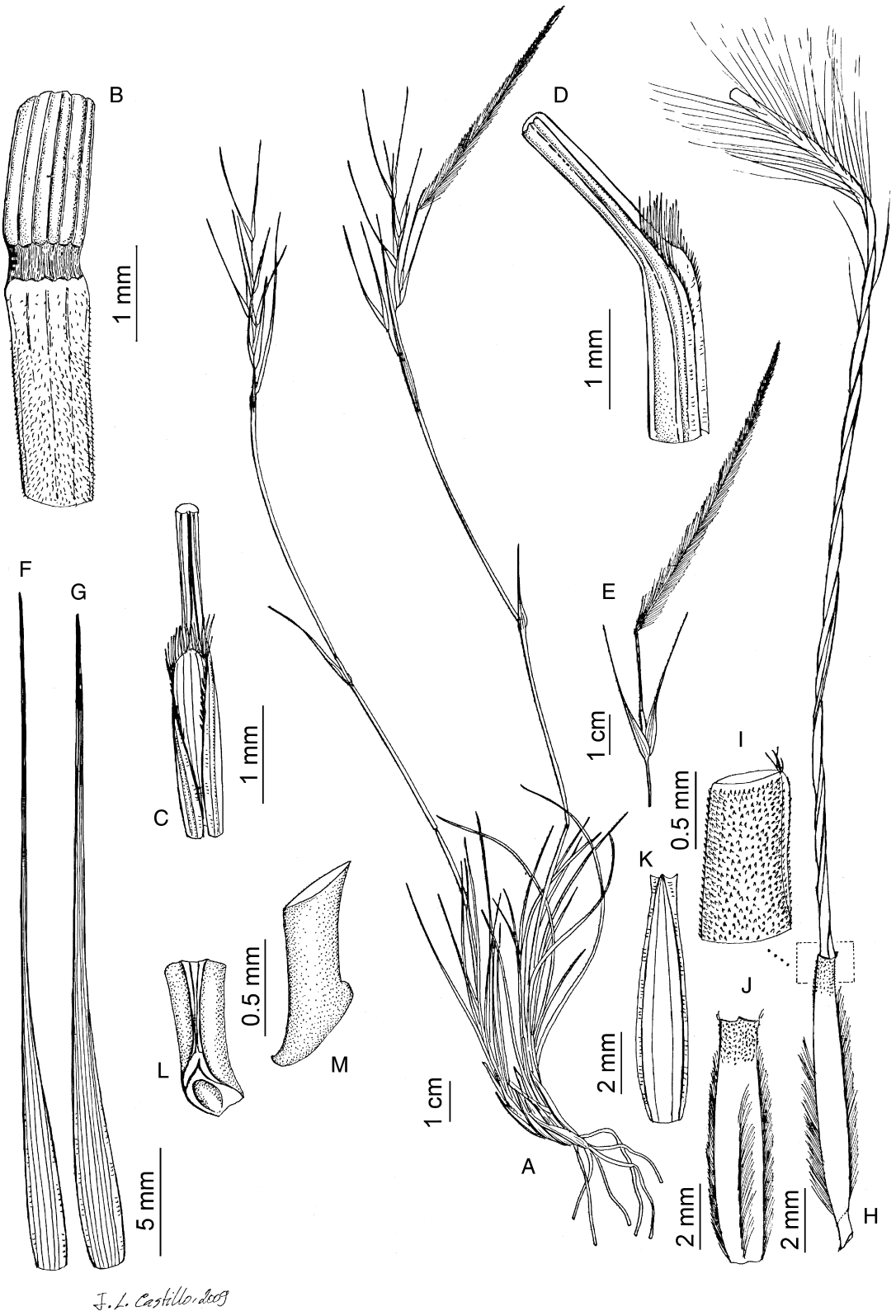

Figure 11. *Stipa karataviensis*: A, habit; B, floriferous culm node; C, ligule, frontal view; D, ligule, lateral view; E, spikelet; F, upper glume; G, lower glume; H, anthecium and column; I, lemma apex; J, lemma; K, palea; L, callus, ventral view; M, callus, lateral view. [Based on: *Lipschitz 92* (S).]

0.55(0.70) mm in diameter, convolute, abaxial surface scabrous (rarely glabrous or sparsely aculeate), aculea (0.01)0.03–0.10(0.17) mm long, adaxial surface pubescent, rarely minutely pubescent (sometimes with longer hairs near the margin), hairs (0.06)0.12–0.22(0.42) mm long; ligules (0.20)0.39–0.67(1.99) mm long, truncate, rounded (rarely acute or lacerate), minutely scabrous or pilose, ciliate, cilia (0.48)0.60–1.49(2.11) mm long. Floriferous culm leaves 9–23 cm long; sheaths 7–18 cm long, the upper sheath sometimes swollen, glabrous, scabrous or papillose (sometimes only somewhat scabrous near the apex and the remainder papillose or glabrous), margins glabrous; blades 0.45–12.00 cm long, (0.12)0.22–0.36(0.42) mm in diameter, abaxial surface scabrous or scattered aculeate, adaxial surface pubescent or minutely pubescent, hairs (0.05)0.09–0.19(0.42) mm long; ligules (0.10)0.50–1.16(2.80) mm long, truncate, rounded or acute, pilose or scabrous, margins and tip ciliate, cilia (0.1)0.3–0.5(0.7) mm long. Panicle (4)8–13(17) cm long, contracted, exserted or partially enclosed by the upper leaf sheath, with (four) five or six (seven) nodes; basal internode (1.1)3.0–8.2(12.1) cm long, scabrous, glabrous or pilose; branches (0.60)0.90–1.70(2.25) cm long, erect-spreading, setose, setae (0.01)0.20–0.38(0.70) mm long; basal nodes with two (three) branches with one or two (three) spikelets each. Glumes equal or subequal, lanceolate, acuminate, glabrous, rarely ciliate on the central nerves, cilia (0.03)0.07–0.17(0.21) mm long, green with margins and tip hyaline, lower glume (2.0)2.2–2.9(3.2) cm long and three-nerved, upper glume (1.9)2.1–2.7(3.2) cm long and (three-) five-nerved. Anthecium (7.2)8.2–8.9(9.4) mm long, (0.6)0.7–0.8(0.9) mm wide, fusiform, coriaceous, green or pale (sometimes purple tinged); lemma (5.1)6.2–6.7(6.9) mm long, near the apex slightly pilose or aculeate, with seven distinct rows of erect hairs, the ventral row ending (0.5)0.9–1.4(2.1) mm below the top (rarely reaching the top), the dorsal one ending 0.83–2.21 mm below the top, the remaining rows slightly shorter than the dorsal row, hairs (0.50)0.73–0.92(1.04) mm long; coronula, hairs (0.2)0.7–1.2(1.5) mm long or lemma apex glabrous; callus (1.6)2.1–2.3(2.8) mm long, acute, curved, villous, hairs (1.04)1.44–1.71(2.19) mm long on the ventral face and (0.49)0.76–0.93(1.20) mm long on the dorsal face, scar elliptic, peripheral ring (0.44)0.54–0.64(0.70) mm long, (0.14)0.16–0.18(0.19) mm wide [ratio width/length = (0.21)0.25–0.35(0.39)]; palea (5.6)6–6.6(7.0) mm long, lanceolate, membranous, margins and tip hyaline, dorsally two-nerved, papillose or glabrous, with the margin glabrous and the tips usually glabrous, rarely with a dorsal line of hairs up to two-thirds the length of the palea, pale or green; lodicules three, equal or subequal, with the ventral ones slightly longer than the dorsal one, acute, lanceolate or linear lanceolate, hyaline, glabrous, dorsal lodicules (1.30)1.72–2.30(2.78) mm long, ventral lodicule (1.30)1.59–2.10(2.64) mm long. Awn (6.0)6.3–8.1(9.3) cm long, unigeniculate; column (1.2)1.3–1.7(2.0) cm long, base (0.30)0.34–0.40(0.45) mm in diameter, twisted, pale, brown, brown and green and usually with purple stains, tuberculate or somewhat scabrous (rarely glabrous at the base and the remainder tuberculate or somewhat scabrous and sometimes with scattered hairs below the geniculation); seta (4.7)5.0–6.3(7.5) cm long, [ratio column length/seta length = (0.17)0.21–0.32(0.34)], straight (rarely falcate), plumose, hairs in lower part (3.26)5.13–6.49(7.12) mm long. Anthers (2.67)3.00–3.93(4.33) mm long, usually glabrous, yellow. Ovary glabrous, styles two. Caryopsis (4.8)4.9–5.5(5.8) mm long, fusiform; embryo (1.10)1.12–1.60(1.70) mm long.

6a. Stipa tianschanica subsp. tianschanica

Plant 17–45 cm tall. Basal leaves 9–23 cm long; blade (0.38)0.41–0.57(0.65) mm in diameter, abaxial surface usually scabrous, adaxial surface pubescent, hairs (0.10)0.12–0.23(0.33) mm long. Glumes (2.2)2.7–2.9(3.2) cm long, anthecium (7.8)8.4–9.0(9.4) mm long; lemma (6.2)6.5–6.7(6.9) mm long, [ratio callus length/lemma length = (0.23)0.24–0.4(0.43)]; coronula, hairs (0.4)0.8–1.2(1.5) mm long; callus 1.6–2.3(2.8) mm long. Awn (6.5)7.8–8.3(9.3) cm long, column (1.2)1.5–1.8(2.0) cm long, seta straight (Figs 12A–L, 15C, D).

Chromosome number: Unknown.

Habitat and distribution: Inhabits rocky and dry slopes, dry steppes, from middle to upper mountain belts. From Tien Shan range of Kyrgyzstan and China (Xinjiang), southwards to Tagdumbasch-Pamir (Xinjiang) and west and central China (Qinghai, Gansu and Xizang). A few populations are found in the south Gobi desert (Mongolia). Also cited from Kazakhstan and Uzbekistan (Wu & Phillips, 2006); 1500–3300 m (Fig. 13).

Phenology: Flowers and fruits from June to September.

Representative specimens examined: CHINA. GANSU: Chianti, Altyntag mountain range 15 km south of Aksai settlement, 39°31′N, 94°59′E, 2.viii.1958, *Petrov s.n.* (LE). XINJIANG: Kashgar: 58–60 km west–north-west of Kashgar along road to Kensu mine & Ulugchat, 39°48′N, 74°21′E, 17.vi.1959, *Junatov* & *I-Fen 704* (LE, NY); Baikurt Settlement 83 km north-

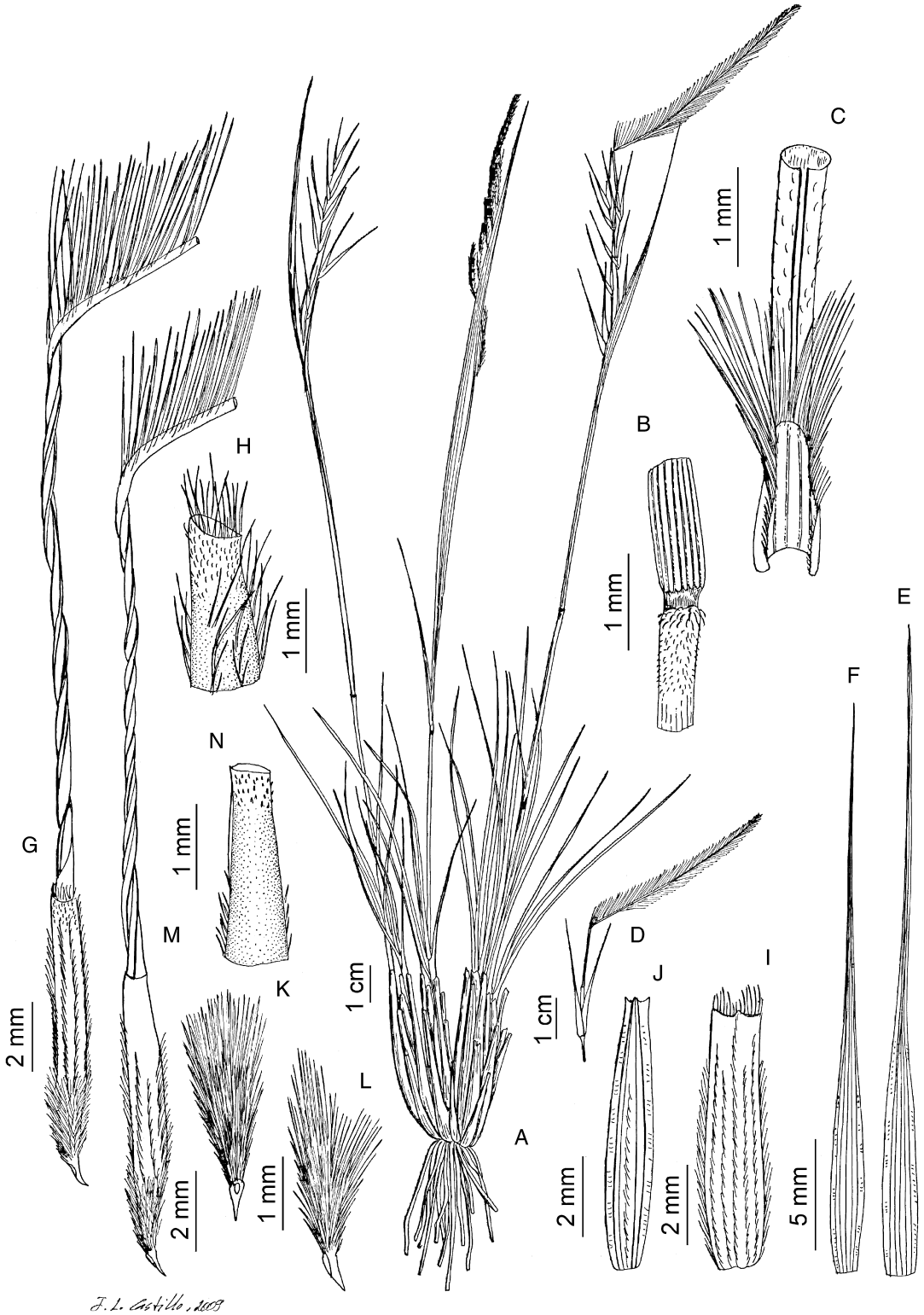

Figure 12. *Stipa tianschanica* subsp. *tianschanica*: A, habit; B, floriferous culm node; C, ligule; D, spikelet; E, upper glume; F, lower glume; G, anthecium and column; H, lemma apex (coronula); I, lemma; J, palea; K, callus, ventral view; L, callus, lateral view. *Stipa tianschanica* subsp. *gobica*: M, anthecium and column; N, lemma apex. [Based on: A–L, *Grubov & Popova* 1.viii.1982 (LE); M, N, *Coll. Rév. P.L. de Smed.* 1923 (BR).]

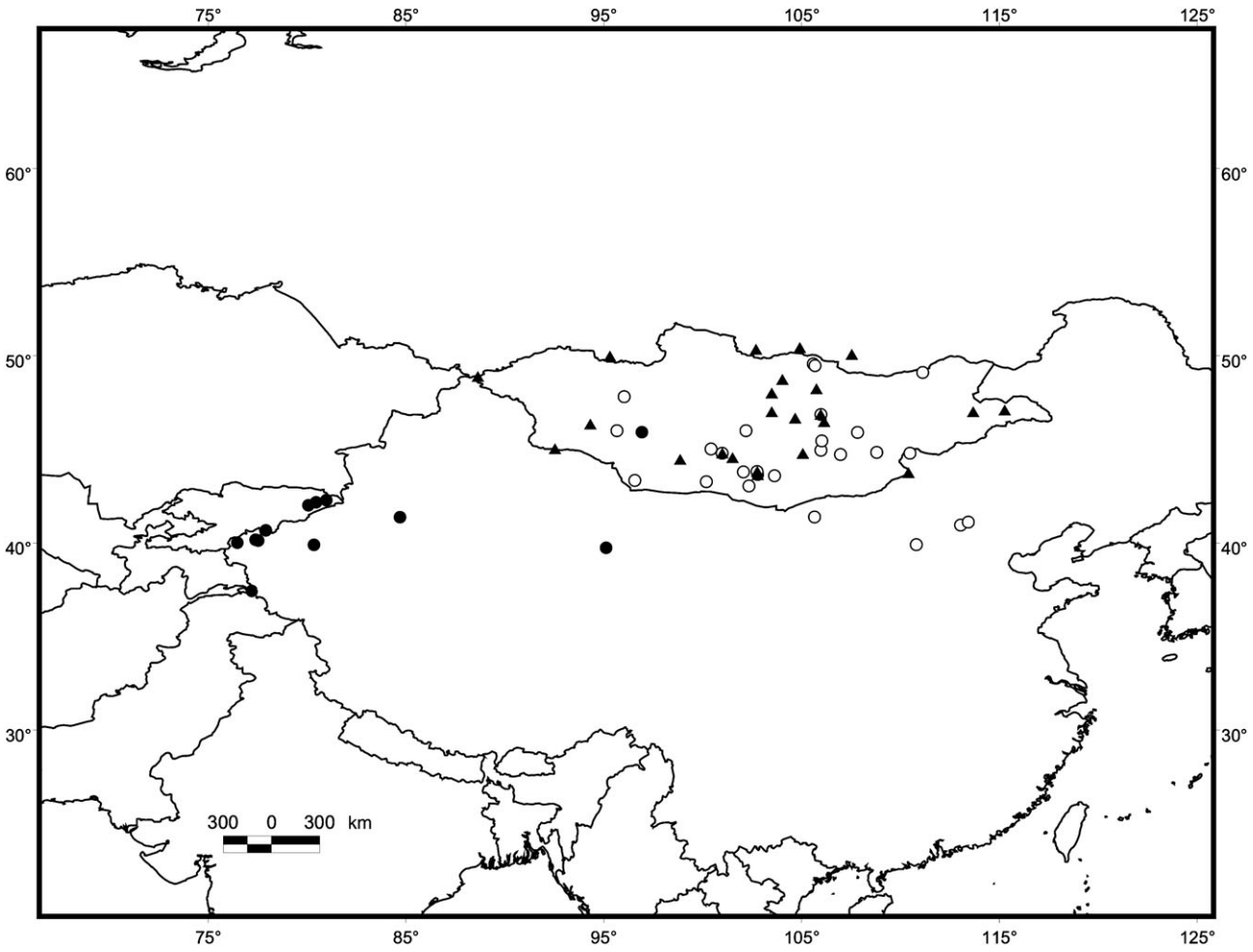

Figure 13. Distribution map: ●, *Stipa tianschanica* subsp. *tianschanica*; ○, *S. tianschanica* subsp. *gobica*; ▲, *S. klemenzii*.

west of Kashgar by Turugart pass, 39°59′N, 75°22′E, 19.vi.1959, *Junatov* & *I-Fen* (LE); southern Tien Shan. At 70 km NW of Kashgar, by Turugart pass, 40°30′N, 75°57′E, 19.vi.1959, *Junatov* & *I-Fen s.n.* (LE); Tien Shan, south slope of Muzart valley river, in its upper part, 41°15′N, 83°27′E, 8.ix.1958, *Junatov* & *I-Fen 892* (K); Kashgara. Kyzylsu river between Shur-Bulak and Kshuiku villages, 39°42′N, 78°39′E, 4.vii.1929, *Popov s.n.* (LE); southern Tien Shan, at 70 km nort-west Kashgar, by Turugart road, 40°30′N, 75°57′E, 19.vi.1959, *Junatov* & *I-Fen 847* (LE). MONGOLIA. GOBI-ALTAI: least rim of Tuilin-Tala plain Guiltar, 46°0′N, 97°00′E, 26.viii.1943, *Junatov s.n.* (LE). ÖMNÖGOVI: southern Gobi. Jan-Jongor Region. At 40–45 km NWN of Dalan–Dzadagad. By the old state highway to Ulan-Bator, 43°37′N, 103°29′E, 10.x.1940, *Junatov s.n.* (LE). KYRGYZSTAN. ISSYK-KUL: Kuylyu range. East of Taldy-su river valley, at 0.5 km of Saraldtaz deep valley river, 42°05′N, 78°45′E, 30.vii.1979, *S. S. Ikonnikov* & *Ladigina 1767* (LE); central Tien Shan. Sari-Dzhas at the low part of Kalida mouth river, 42°12′N, 79°20′E, 1.viii.1982, *Grubov* & *Popova s.n.* (LE).

6b. Stipa tianschanica subsp. gobica (Roshev.) D.F.Cui in N.R.Cui

Stipa tianschanica subsp. *gobica* (Roshev.) D.F.Cui in N.R. Cui, Fl. Xinjiangensis 6: 299. 1996. *Stipa gobica* Roshev., Bot. Mater. Gerb. Glavn. Bot. Sada RSFSR 5: 13. 1924. *Stipa tianschanica* var. *gobica* (Roshev.) P.C.Kuo & Y.H.Sun in T.T. Yu & L.T. Lu, Fl. Reipubl. Popul. Sin. 9(3): 277. 1987. *Type:* MONGOLIA. Ad ripam fl. Tuingol infra confluentum Scharagoldshuta, 8.vii.1893, *Klemenz 166H* (lectotype: LE, designated by Tzvelev, 1968).

Stipa potaninii Roshev., Bot. Mater. Gerb. Glavn. Bot. Sada RSFSR 5: 13. 1924. *Type:* MONGOLIA. Between Nemegetu & Zomzo Mts, 20.viii.1886, *Potanin s.n.* (holotype: LE!; isotypes: LE!, W!).

Stipa sinomongholica Ohwi, J. Jap. Bot. 19: 168. 1943. *Type:* MONGOLIA. Mongholia interior. *Togashi 737* (holotype: TI?).

S. gobica var. *pubescens* Hanelt & Davazamc, Feddes Repert. 70: 13. 1965. *Type:* MONGOLIA. N-Abfall des Cagn-bogd, Felshänge *1041a.* (type: unknown).
S. gobica var. *wulateica* Y.Z.Zhao, Acta Sci. Nat. Univ. Intramongol. 23(4): 546. 1992. *Stipa wulateica* (Y.Z.Zhao) Y.Z.Zhao, Acta Sci. Nat. Univ. Neimenggu. 27(2): 211. 1996. *Type:* CHINA. Nei-Mongol, Langshan, *Zhao Yizhi et al*. 7025 (holotype: HIMC).

Plant 10–33 cm tall. Basal leaves 8–32 cm long; blade (0.34)0.41–0.53(0.70) mm in diameter, abaxial surface somewhat scabrous, sparsely aculeate or glabrous, adaxial surface pubescent or minutely pubescent, hairs (0.06)0.13–0.20(0.42) mm long. Glumes (1.90)2.15–2.40(2.70) cm long, anthecium (7.2)8.1–8.8(9.3) mm long, lemma (5.1)6.1–6.6(6.9) mm long, [ratio callus length/lemma length = (0.29)0.33–0.4(0.42)]; lemma apex glabrous, more rarely with scattered hairs; callus (1.8)2.1–2.3(2.5) mm long. Awn (6.0)6.3–7.3(8.0) cm long, column (1.2)1.3–1.5(1.9) cm long, seta straight (rarely falcate) (Figs 12M, N, 15E, F).

Additional illustrations: Tzvelev (1968: pl. II, fig. 5); Y.Z. Zhao (1992: 548, fig. 2, sub. *S. gobica* var *wulateica*); Cui (1996: 298, figs 9–14).

Chromosome number: Unknown.

Habitat and distribution: Inhabits rocky, sandy and gravelly slopes from plains, tail of mountains and hills up to low mountain belts, gorges, dry steppes, and sandy or stony deserts. Through Mongolia to north and central China; 800–2400 m (Fig. 13).

Phenology: Flowers and fruits from May to September.

Representative specimens examined: CHINA. KALGAN: 40°48′N, 114°50′E, 20–21.vii., *Cowday 1519* (NY); HEBEI: Environ Si-Wantze Chihli, 40°58′N, 115°16′E, 1923, *Smed. s.n.* (BR); SHANZI: north Shanxi province. Datun district, at 8 km west the city, 39°42′N, 112°21′E, 21.v.1957, *Petrov s.n.* (LE); XINJIANG: Sinitzian-Uigursk province. Eastern Djugar, at 112–115 km of Ertai to Urunguat south by Guchen road, 90°0′N, 45°0′E, 16.vii.1959, *Yunatov & I-Feni s.n.* (LE). GANSU. Opp. Tzsjutzjuan (Chi ucze). Czi-liujshang mountains, 22.ix.1958, *Lavrenko & Lin-tzy 120* (LE); Kanson septentrional. Hai Sch'eng ze, 18.vi.1918, *Licent 3940* (W); 90 km south-west of In'chuan town, 18.vi.1958, *Petrov s.n.* (LE). MONGOLIA. BULGAN: Gurvan-Sayjan range. At 22 km south Bulgan, 45°32′N, 107°03′E, 22.vi.1974, *Kazantseva s.n.* (W). DORNOGOVI: eastern Gobi. Region Erdini. Usun-Gulu mountain at E of Erdini, 44°50′N, 112°00′E, 14.vi.1941, *Junatov s.n.* (LE). DORNOD: Mongolia australis: Khujertu-gol Camp. VIII, 49°22′N, 112°42′E, 2.vii.1927, *Hummel 1091* (S). DUNDGOVI: central Gobi. Region Bujantu. At 8 km north of Talain-Chuduk, 45°00′N, 107 00′E, 7.v.1941, *Tugarikov s.n.* (LE). KHENTII; Mongolia australis: Hutjerta-gol Camp, 49°22′N, 112°42′E, 2.vi.1927, *Hummel 1091* (S). KOBDO: Dzapjin. Tragan-Olom district. At 25 km west Tragan-Olom by Kobdo road, 48°0′N, 96°0′E, 28.viii.1944, *Junatov s.n.* (LE). GOBI-ALTAI. Alasham desert. Bayan Khoto. Kamensujaitu, at 8 km SE of Bain-Ula mountain, 46°6′N, 95°37′E, 13.vii.1958, *Petrov s.n.* (LE); Gobi. Region Bani-Undur. Forest Juju-Us at 15–20 km SE of Ata-Bogdo, 43°18′N, 96°36′E, 11.viii.1943, *Junatov s.n.* (LE); ÖMNÖGOVI: southern Gobi. Region Jurmeni. Southern slopes of Gurban-Saykhan, 43°49′N, 103°27′E, 19.vii.1950, *Kalinnikov s.n.* (LE); north slope of Dzun-Saykan range, road of Dalan-Dzadagada to Elo-Ama, 43°34′N, 104°25′E, 21.vii.1970, *Grubov & al. 191* (LE); Gobi-Mongolia. Southern Nochjan Somon. Gobi-Altai: southern Tosto-Nuru range close to N-E slope of Obeti-Chjar hill, 43°14′N, 100°36′E, 28.vii.1943, *Junatov s.n.* (LE, K). ÖVÖRKHNAGAI: Region Chayrchan-Dulan. At 40 km SW by Bayan Khoto road, 46°6′N, 102°50′E, 27.vi.1941, *Tsatsekin s.n.* (LE). SELENGE: Mongolia interior: 7.5 km ad bor.-orient Khadain-sume, 49°50′N, 106°35′E, 26.vii.1936, *Eriksson 887* (S).

Notes: Stipa tianschanica may be easily distinguished from the other species with a straight awn and glabrous column (*S. longiplumosa*, *S. talassica* and *S. lingua* subsp. *lipskyi*) by its shorter spikelets and awns. This species shares the same distribution area as *S. caucasica*, being frequently found on the same sheet and misidentified. However, *S. caucasica* may be distinguished from *S. tianschanica* by its falcate awns and pilose column.

Until 1987, both subspecies were considered to be closely related species. Nevertheless, in recent floras, *S. gobica* has been treated as a variety or a subspecies of *S. tianschanica* (Kuo & Sun, 1987; Cui, 1996; Wu & Phillips, 2006). The most distinctive character separating subsp. *tianschanica* from subsp. *gobica* is the presence of a coronula at the lemma apex which, in subsp. *gobica*, is glabrous. However, some specimens of *S. gobica* have scattered hairs at the lemma apex, and may be mistaken for subsp. *tianschanica*, especially in central China (Gansu, Qinghai, Shaanxi and Xinjiang), where both taxa are found. The character that has been used to separate these two taxa in most of the floristic treatments is the size of the structures of the spikelets. *Stipa tianschanica* subsp. *tianschanica* usually has slightly longer awns and glumes, but, in

many cases, this separation is not as clear. Under these circumstances, we agree to adopt the subspecific rank for these taxa (Tzvelev, 1976; Cui, 1996).

Stipa potaninii has been separated from subsp. *gobica* by its shorter awn (5.5–6.5 mm vs. 6.5–8.5 mm) and its shorter seta hairs (3 mm vs. 5–6 mm). A careful examination of the plants studied showed that most of the specimens are intermediate between the taxa and there are no noticeable differences.

Unfortunately, the types of *S. gobica* subsp. *wulateica*, *S. sinomongholica* and S. *gobica* var. *pubescens* could not be studied, but the original descriptions and previous taxonomic treatments (Tzvelev, 1968; Cui, 1996) suggest that they are better considered as synonyms of *S. tianschanica* subsp. *gobica*. *Stipa gobica* var. *wulateica* has been distinguished by its shorter lemma (4.5–6.0 mm) and column (5–10 mm), and *S. sinomongholica* by its longer callus (1.5–2.0 mm) and shorter column (12–13 mm), almost scabrous. However, these characters were rather variable among the specimens studied. In *S. gobica* var. *pubescens*, the sheaths of the upper cauline leaves are minutely pubescent, but the sheath surface is similarly variable in most of the species studied and of no relevance for the delimitation of taxa.

The holotype of *S. tianschanica* ('Prov. Semiretschje: distr. Prshewalsk, ad cursum inferiorum fl. Ak-Schiirjak in declivibus petrosis, 31.vii.1913, *Schischkin s.n.*') was deposited in LE (Tzvelev, 1976). However, during our stay in LE, this type was not found. Therefore, a thorough investigation is needed to locate the original material in LE. Additional Schischkin's type material might be found in MW, TK or VLA suitable for lectotypification.

7. Stipa klemenzii Roshev

Stipa klemenzii Roshev., Bot. Mater. Gerb. Glavn. Bot. Sada RSFSR 5: 12. 1924. *Stipa gobica* var. *klemenzii* (Roshev.) Norl., Fl. Mong. Steppe 1: 66. 1949. *Stipa tianschnica* var. *klemenzii* (Roshev.) Z.L.Wu & Phillips in Z.Y. Wu & P.H. Raven (eds.), Fl. China 22: 199. 2006. *Type:* MONGOLIA. Ad ripam fl. Charuchi, 25.vi.1895, *Klemenz 72a* (lectotype: LE! designated by Tzvelev, 1976).

Herbs 8–24 cm tall, perennial, loosely caespitose; branching intravaginal. Culms with two (or three) nodes, nodes glabrous, violet; culm internode usually glabrous beneath the node, the remainder glabrous (rarely papillose or scabrous). Basal leaves 8–23 cm long, green and pruinose; sheaths scabrous, papillose or minutely pubescent, ciliate, cilia (0.17)0.24–0.56(1.04) mm long; blades 7–20 cm long, (0.33)0.40–0.43(0.61) mm in diameter, convolute, abaxial surface glabrous or sparsely aculeate, adaxial surface minutely pubescent or pubescent, hairs (0.05)0.10–0.16(0.25) mm long; ligules (0.4)0.7–1.3(1.6) mm long, rounded, truncate (rarely acute), minutely scabrous, ciliate, cilia (0.4)0.5–0.9(1.6) mm long. Floriferous culm leaves 7–18 cm long; sheaths 3–13 cm long, the upper sheath sometimes swollen, scabrous near the apex and the remainder papillose or glabrous, margins glabrous; blades 2.0–8.6 cm long, (0.2)0.3–0.4(0.5) mm in diameter, abaxial surface glabrous or scattered aculeate, adaxial surface minutely pubescent or pubescent, hairs (0.08)0.10–0.17(0.22) mm long; ligules (0.20)0.67–1.39(2.29) mm long, rounded, truncate, acute or lacerate, and the longest ones usually convolute, scabrous (rarely glabrous), margin usually glabrous, tip ciliate, cilia (0.08)0.27–0.58(0.91) mm long. Panicle 4–11(15) cm long, contracted, usually enclosed by the upper leaf sheath, with four (or five) nodes; basal internode (0.20)0.65–6.70(11.40) cm long, glabrous (rarely minutely scabrous); branches (1.20)1.35–1.45(1.90) cm long, erect or erect-spreading, setose, setae (0.12)0.17–0.28(0.29) mm long; basal nodes with one or two branches with one (two) spikelet(s) each. Glumes subequal, lanceolate, acuminate, glabrous, rarely ciliate on the central nerves, cilia (0.03)0.06–0.13(0.18) mm long, green and usually purplish tinged, with the margin and tips usually hyaline, lower glume (3.0)3.2–3.6(4.4) cm long and three-nerved, upper glume (2.9)3.1–3.5(4.3) cm long and (four-) five-nerved. Anthecium (9.6)10.0–11.0(11.3) mm long, (0.63)0.71–0.79(0.85) mm wide, fusiform, coriaceous, pale or green; lemma (6.7)7.1–7.6(8.0) mm long, near the apex usually glabrous, with seven rows of erect or erect-spreading hairs with the dorsal and the ventral row distinct and the subdorsal and lateral row lines fused for three-quarters of their length (sometimes fused and modified to one line), the ventral row ending 2.6–4.6 mm below the top, the dorsal one measuring one-third to one-half of the length of the lemma, the remaining rows measuring one-quarter to one-third of the length of the lemma, hairs (0.45)0.52–0.66(0.73) mm long; lemma apex glabrous; callus (2.5)2.9–3.4(3.8) mm long, acute, curved, villous, hairs (1.17)1.20–1.40(1.50) mm long on the ventral face and (0.70)0.77–0.90(1.15) mm long on the dorsal face, scar elliptic, peripheral ring (0.35)0.45–0.60(0.63) mm long, (0.06)0.14–0.16(0.17) mm wide [ratio width/length = (0.17)0.23–0.33(0.35)]; palea (6.90)6.95–7.47(7.70) mm long, lanceolate, membranous, margins and tip hyaline, dorsally two-nerved, between the two nerves papillose or glabrous, margins and tip glabrous, rarely with a dorsal line of hairs up to two-thirds the length of the palea, green; lodicules three, subequal, with the dorsal ones usually shorter than the ventral one, acute, lanceolate or linear-lanceolate, hyaline, glabrous, dorsal lodicules (1.25)1.34–1.75(2.53) mm long, ventral lodicule (1.40)1.48–1.81(1.99) mm long. Awn (9.8)11.3–13.2(14.0) cm long, unigeniculate;

column (1.5)2.0–2.3(2.6) cm long, base (0.33)0.43–0.48(0.52) mm in diameter, twisted, pale, brown or brown and green, glabrous; seta (7.8)9.5–11.0(11.4) cm long, [ratio column length/seta length = (0.15)0.17–0.23(0.26)], falcate, plumose, hairs in lower part (4.84)5.45–6.46(7.41) mm long. Anthers (2.50)3.58–4.30(5.14) mm long, glabrous, yellow. Ovary glabrous, styles two. Caryopsis (5.08)5.23–6.10(6.23) mm long, fusiform; embryo (1.20)1.30–1.60(1.78) mm long (Figs 14, 15G, H).

Chromosome number: Unknown.

Habitat and distribution: Inhabits rocky slopes and sandy steppes from lowland to lower mountain belts. Restricted to Mongolia, Nei Mongol (China) and south and central Siberia, close to the Mongolian border; 600–2300 m (Fig. 13).

Phenology: Flowers and fruits from June to early November.

Representative specimens examined: MONGOLIA. BAYANKHONGOR: southern Gobi. Jan-Jongor Region. At 40–45 km NWN of Dalan–Dzadagad. By the old state highway to Ulan-Bator, 43°37′N, 103°29′E, 10.x.1940, *Junatov s.n.* (LE); Baga-Bogdo range. South Beli-Urog. Ermen Tologoi, 44°50′N, 101°30′E, 18.ix.1943, *Junatov s.n.* (LE). BULGAN: Ad ripam fl. Khorukha, 48°12′N, 104°16′E, 25.vi.1895, *Klemenz 72a* (LE). DORNOD: Region Matad, at 20 km south of Matad, 47°09′N, 115°32′E, 25.vii.1956, *Dashniam s.n.* (LE); Region Matad. At 18–20 km W-N-W Thamtzag-Bulak, 47°15′N, 117°18′E, 14.viii.1949, *Junatov s.n.* (LE). DORNOGOVI: eastern Gobi. Region Erdeni. Forest zone of Baroja-Tala, at south of Dzamin-Ude, 43°45′N, 111°55′E, 16.vi.1941, *Junatov s.n.* (LE); central Gobi. Region Kholtu. Plain 15 km N-E Oldakhu-Khid monastery, 44°49′N, 106°00′E, 10.vi.1951, *Kalinina s.n.* (LE). GOBI-ALTAI: Gobi to Juisin, 27 km east of Salt lakes by the path to Daribi, 46°27′N, 94°7′E, 21.vi.1971, *Grubov, Ulziijutag & Darshima s.n.* (LE). KHOVD: steppe between Argali forest and Tsecheg lake, by the road to Zain-Sadi, 45°5′N, 92°8′E, 26.vii.1924, *Pavlov 165* (LE); central Mongolia: 2.5 km ad orient. Summit Wang, in gobi, 19.vi.1934, *Eriksson 696* (S); Mongolia: Khujirtu-gol, 5.vii.1927, *Hummel s.n.* (S). ÖMNÖGOVI: southern Gobi. Region Khongor. Desert plain at north of Gurban-Saikhan and Dzun-Saikhan, 43°49′N, 103°27′E, 22.vii.1943, *Junatov s.n.* (LE); 35 km N-E of east rim of Artsa-Bogdo mountain range, 44°35′N, 102°04′E, 28.x.1941, *Junatov 145* (LE); Prov. Bain-Ulegei. Region Tragan-Nur. Khuityn-Khutyl mountain crossing south of Tsagan-Nur on road to Kobdo, 49°8′N, 87°49′E, 4.viii.1945, *Junatov s.n.* (LE). ÖVÖRKHANGAI: Gobi, Artsa Bogdo range, southern slope at at 3 km from the pass by the path to Kobdo, 44°35′N, 102°4′E, 16.vii.1970, *Grubov, Ulziijutag & Tsereibaljid s.n.* (LE). TÖV: 60 km south-west of Ulan Bator along road to Ubur Hangay, 46°36′N, 107°11′E, 18.vii.1949, *Junatov s.n.* (LE); 120 km south of Ulan Bator, 46°29′N, 107°01′E, 11.viii.1950, *Junatov s.n.* (LE); central Khalkha, North-west Undzhul, 46°47′N, 105°34′E, 27.vi.1974, *Golubkova Tsogin & Tsatsegina 116* (LE); north slope of Tszaja mountain in Sugnur river plain, 48°26′N, 106°46′E, 10.vii.1924, *Pavlov 167* (LE); Bain-Barat Region, 120 km of Ulan-Batora, 47°00′N, 107°00′E, 11.viii.1950, *Kalinina s.n.* (LE). RUSIA. BURYA: southern slope of Bartoy range, 50°40′N, 103°23′E, 20.vii.1972, *Petshikov s.n.* (LE). TUVA: Ereinskiyc. Erein. Bulun-Bazhy, 50°16′N, 95°12′E, 22.vii.1972, *Timojina & Mrijin 3193* (LE).

Notes: Stipa klemenzii may be distinguished by its falcate awn and glabrous column. Although these two characters are shared with *S. alaica*, the glabrous lemma apex and the relatively shorter awn, (9.85)11.30–13.20(14.00) cm long, can be used to separate it from *S. alaica*, which has a coronula or scattered hairs and slightly longer awns, (12.45)14.12–16.10(17.50) cm long. Another feature that assists in distinguishing *S. klemenzi* is the subdorsal and lateral lemma rows fused for at least three-quarters of their length, whereas other species (except *S. mongolorum* and *S. gaubae*, which are completely hairy) exhibit distinct rows.

Stipa klemenzii and *S. caucasica* are the only species of the section reported from Siberia. These species share a falcate awn; however, they may be distinguished by the column surface, which is glabrous in *S. klemenzii* and pilose in *S. caucasica*.

Stipa klemenzii has been traditionally compared with *S. tianschanica* and *S. gobica* (Roshevitz, 1924; Norlindh, 1949; Tzvelev, 1968, 1976; Wu & Phillips, 2006). Roshevitz (1924) distinguished *S. klemenzii* from *S. tianschanica* by the absence of a coronula and the glabrous or subglabrous column, and from *S. gobica* and *S. potanini* by its smaller glumes, anthecium and awn, and the glabrous or subglabrous column. That view was upheld by Tzvelev (1976) who additionally emphasized the glabrous abaxial surface of the basal blades (scabrous in *S. tianschanica* and *S. gobica*).

The qualitative characters given by Roshevitz and Tzvelev are not consistent, because specimens with tuberculate columns and somewhat scabrous or scattered aculeate abaxial blade surfaces may be found throughout the distribution area. However, *S. klemenzii* is easily distinguished from *S. tianschanica* by the larger size of the spikelet structures, the lemma surface mentioned above and its falcate awn. Some

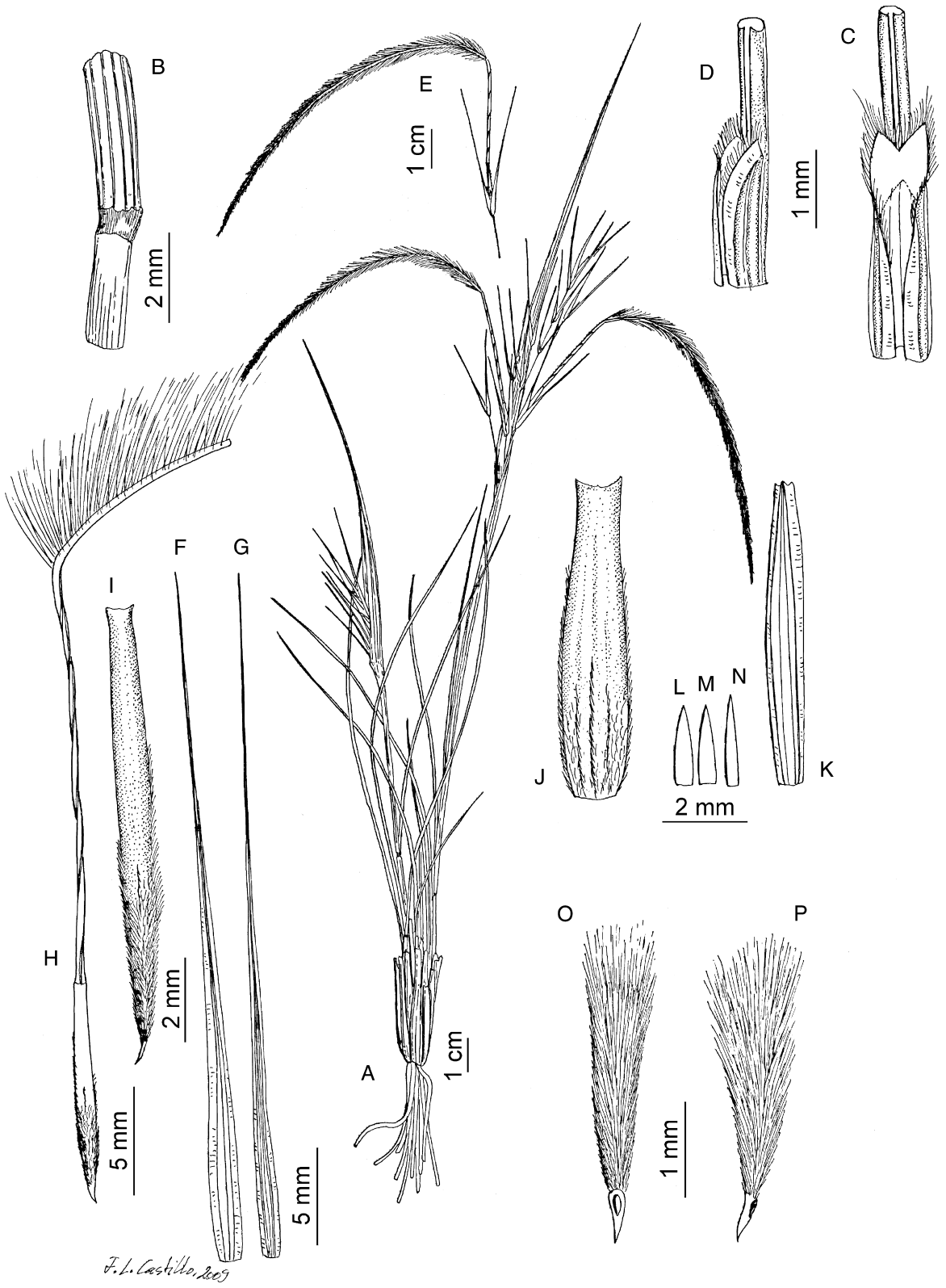

Figure 14. *Stipa klemenzii*: A, habit; B, floriferous culm node; C, ligule, frontal view; D, ligule, lateral view; E, spikelet; F, upper glume; G, lower glume; H, anthecium and column; I, anthecium; J, lemma; K, palea; L, M, dorsal lodicules; N, ventral lodicule; O, callus, ventral view; P, callus, lateral view. [Based on: *Eriksson 887* (S).]

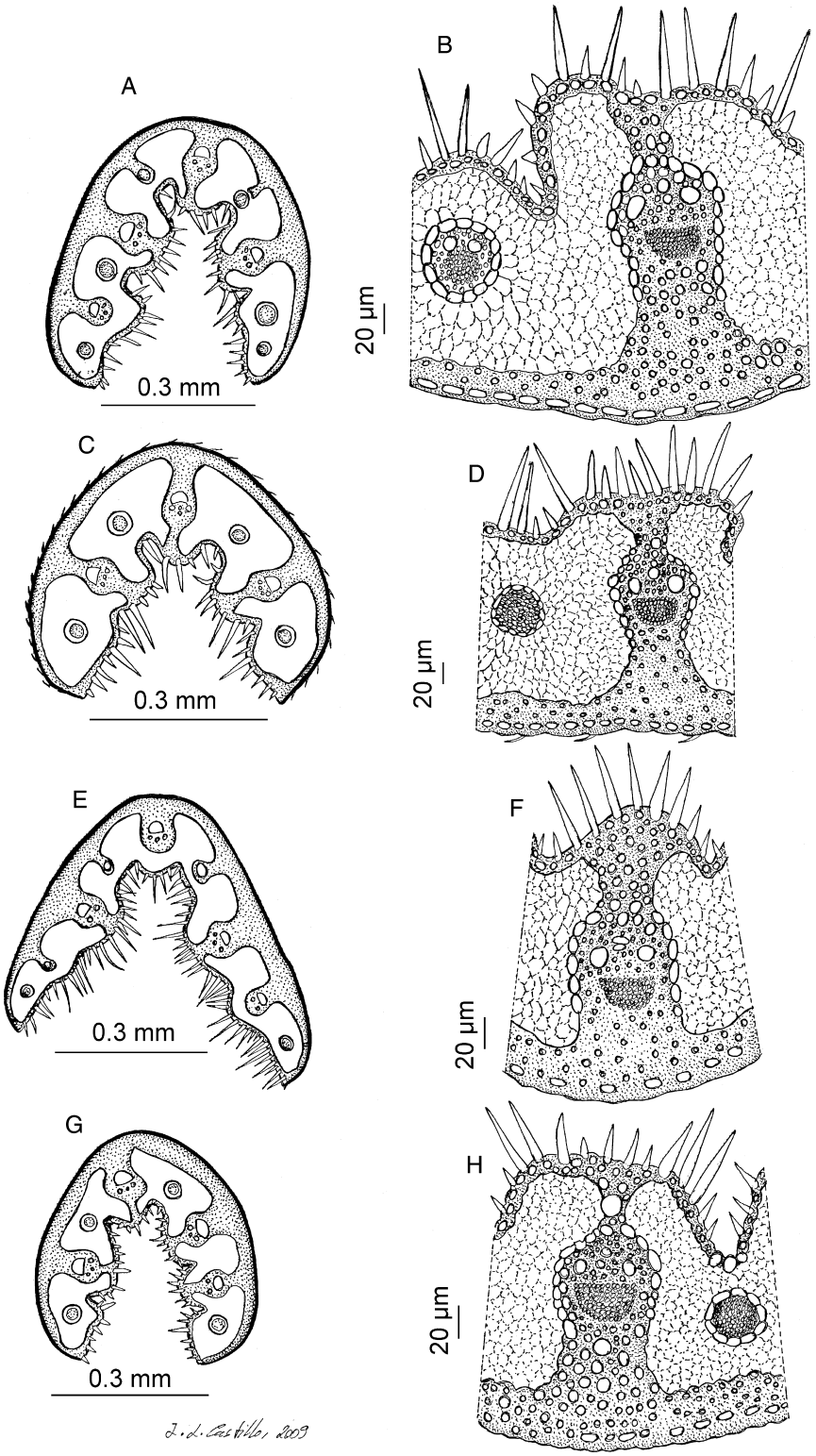

Figure 15. *Stipa karataviensis*: A, transverse section of leaf blades; B, central nerve of leaf blades. *Stipa tianschanica* subsp. *tianschanica*: C, transverse section of leaf blades; D, central nerve of leaf blades. *Stipa tianschanica* subsp. *gobica*: E, transverse section of leaf blades; F, central nerve of leaf blades. *Stipa klemenzii*: G, transverse section of leaf blades; H, central nerve of leaf blades. [Based on: A, B, *Lipschitz 92* (S); C, D, *Grubov and Popova* 1.viii.1982 (LE); E, F, *Coll. Rév. P.L. de Smed.* 1923 (BR); G, H, *Eriksson 887* (S).]

specimens of subsp. *gobica* (*S. potanini*) also have a falcate awn, but, in this case, the awn is never longer than 8 cm.

8. Stipa longiplumosa Roshev

Stipa longiplumosa Roshev. in V.L. Komarov (ed.), Fl. URSS 2: 87. 1934. *Type:* TAJIKISTAN. Eastern slope of Sarsaryak range, environs of Margak kishlak, hills at 2–3 km southeast Margak, 7.vi.1932, *Gontcharow, Grigorjev & V. A. Nikitin 227* (holotype: LE!).

Herbs 16–57 cm tall, perennial, densely caespitose; branching intravaginal. Culms with four (five) nodes, nodes glabrous, violet; culm internode minutely pubescent. Basal leaves 13–39 cm long, green; sheaths glabrous, scabrous (rarely minutely pubescent), margin glabrous or ciliate, cilia 0.20–0.32 mm long; blades 8–34 cm long, (0.47)0.48–0.65(0.67) mm in diameter, convolute or conduplicate, abaxial surface distinctly scabrous, adaxial surface distinctly scabrous or papillose, aculea or papillae (0.02)0.05–0.10(0.13) mm long; ligules 0.15 mm long, replaced by a line of hairs or truncate, ciliate, cilia 0.40–0.54(0.90) mm long. Floriferous culm leaves 12–34 cm long; sheaths 8–30 cm long, the two upper sheaths usually swollen, scabrous, papillose or glabrous, margins glabrous; blades 1–11 cm long, (0.16)0.23–0.49(0.58) mm in diameter, abaxial surface glabrous or scabrous, adaxial surface scabrous, aculea 0.01–0.05 mm long; ligules (0.45)0.50–1.31(1.45) mm long, truncate, rounded (rarely acute), scabrous or pilose, glabrous or more rarely ciliate, cilia (0.19)0.30–0.49(0.65) mm long. Panicle (5)6–29(32) cm long, contracted, exserted or enclosed by the upper leaf sheath, with three or four nodes; basal internode (0.5)0.7–22.6 cm long, scabrous (rarely scattered pilose); branches 0.7–2.1(2.5) cm long, erect, setose, setae (0.12)0.28–0.46(0.50) mm long; basal nodes with two branches with one spikelet each. Glumes subequal, lanceolate, long acuminate, glabrous, rarely ciliate on the central nerves, cilia (0.05)0.62–0.10(0.13) mm long, green or pale with margins and tip hyaline, lower glume (6.20)6.85–8.35(9.00) cm long and three- to five-nerved, upper glume (6.10)7.00–7.95(8.40) cm long and five- to seven-nerved. Anthecium (12.3)13.0–14.2(14.7) mm long, (0.95)1.21–1.41(1.50) mm wide, fusiform, coriaceous, pale or brown; lemma (9.9)10.5–11.5(12.2) mm long, near the apex glabrous, with seven distinct rows of erect-spreading hairs, the ventral row ending (1.5)1.9–2.8(3.0) mm below the top, the dorsal one measuring one-third to one-half the length of the lemma, the remaining rows ± equalling the dorsal row, hairs (0.57)0.80–0.90(1.00) mm long; lemma apex glabrous (rarely with scattered hairs); callus (2.3)2.4–2.6(2.7) mm long, acute, curved, villous, hairs (1.28)1.45–1.84(2.00) mm long on the ventral face and (0.75)0.83–1.02(1.14) mm long on the dorsal face, scar circular, peripheral ring (0.65)0.85–0.95(1.02) mm long, (0.31)0.33–0.35(0.39) mm wide [ratio width/length = 0.3–0.47]; palea (10.2)10.5–11.9(12.0) mm long, lanceolate, membranous, margins and tip hyaline, dorsally two-nerved (rarely with two secondary nerves terminating before the top), between the two nerves papillose or glabrous, margins glabrous and tip ciliate, rarely with a dorsal line of hairs up to two-thirds of the length of the palea, pale or brown; lodicules three, equal or subequal, with the dorsal ones slightly longer than the ventral one, acute, lanceolate or linear-lanceolate, hyaline, glabrous, dorsal lodicules (1.95)2.15–2.76(3.35) mm long, ventral lodicule(1.75)1.89–2.64(3.35) mm long. Awn (19.0)19.6–23.7(25.1) cm long, unigeniculate; column (2.80)3.75–5.10(6.00) cm long, base (0.52)0.62–0.73(0.79) mm in diameter, twisted, pale or brown, glabrous and more rarely slightly tuberculate below the geniculation; seta (13.50)15.80–19.25(21.00) cm long (ratio column length/seta length = 0.19–0.41), straight, plumose, hairs in lower part (8.17)8.73–10.04(11.97) mm long. Anthers (5.00)5.41–7.45(7.46) mm long, usually glabrous, yellow. Ovary glabrous, styles two. Caryopsis (8.90)8.94–9.61(9.75) mm long, fusiform; embryo (2.89)3.00–3.20(3.29) mm long (Figs 16, 22A, B).

Chromosome number: Unknown.

Habitat and distribution: Inhabits rocky slopes and sandy soils of lower mountain belts, from Pamir and Alai mountains of Tajikistan and Kyrgyzstan (Fig. 7).

Phenology: Flowers and fruits from May to July.

Representative specimens examined: TAJIKISTAN. KHATLON: west slope of North Aruk-Tau, 37°47′N, 68°32′E, 13.vi.1959, *Chukavina 676* (LE). REGION OF REPUBLICAN SUBORDINATION: SE slope of Babatag range close to Ak mechet', 38°28′N, 68°10′E, 5.vi.1938, *Linchevskii 281* (LE); Jugum Babatag, fere meridiem versus ab urb Djuschambe, 38°33′N, 68°46′E, 11.vii.1931, *Gontscharov 94* (B, FI, G, H, L, LE, S); Pamir, at the top of Babatag mountain, 38°45′N, 68°00′E, 25.ix.1935, *Prianishkov 126* (JE). KYRGYZSTAN. OŠ: Alai range, clay slopes at 15 km south of Oš village to Iski-Naukat village, 40°16′N, 72°36′E, 9.vi.1958, *Tzvelev 7* (LE); Altai range, clay slopes at 15 km south of Oš village to Iski-Naukat village, 40°16′N, 72°36′E, 9.vi.1958, *Tzvelev 5* (LE); Altai at 15 km south of Oš to Iski-Naukat, 40°16′N, 72°36′E, 9.vi.1958, *Tzvelev 38* (LE).

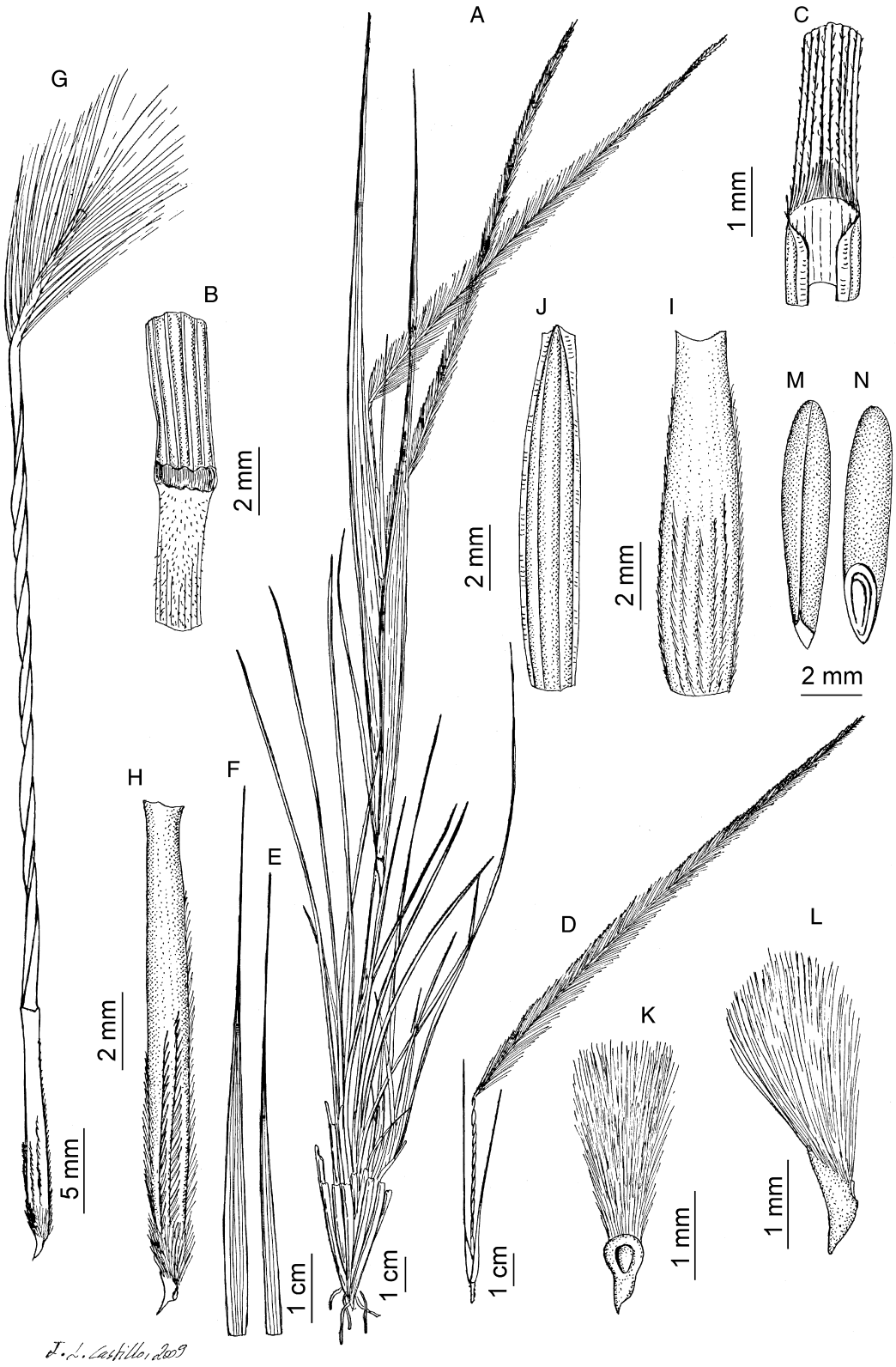

Figure 16. *Stipa longiplumosa*: A, habit; B, floriferous culm node; C, ligule; D, spikelet; E, upper glume; F, lower glume; G, anthecium and column; H, anthecium; I, lemma; J, palea; K, callus, ventral view; L, callus, lateral view; M, caryopsis, ventral view; N, caryopsis, dorsal view. [Based on: *Prianishkov 126* (JE).]

Notes: This species is apparently quite similar to *S. lingua* subsp. *lipskyi*, but, after a careful examination, they have several evident differences, as pointed out by Roshevitz (1932), Pazij (1968) and Tzvelev (1976). *Stipa longiplumosa* may be readily distinguished by its glabrous lemma apex (rarely with scattered hairs), callus without expanded base, and blades with scabrous abaxial and papillose adaxial surfaces, whereas *S. lingua* subsp. *lipskyi* has a coronula, callus foot-like expanded and blades with glabrous abaxial and long pubescent adaxial surfaces. In addition, *S. longiplumosa* has slightly longer awns, columns and seta hairs.

9. Stipa alaica Pazij

Stipa alaica Pazij in S.S. Kovalevskaja, Conspect. Fl. Asiae Mediae 1: 76, 200. 1968. *Type:* TAJIKISTAN. Alai range, southwestern slope of the right bank of Kzylsu, 50 km west of Sary-Tash, 1.viii.1962, *Puchkova 152* (holotype: TAK digital image!).

Stipa manrakica Kotukhov, Bot. Zhurn. (Moscow & Leningrad) 74: 414. 1989. *Type:* KAZAKHSTAN. Kazachstania Orientalis, jugi Manrak pars centralis, locus Sagyndyk Major, 27.vi.1986, *Kotukhov s.n.* (holotype: LE!).

Stipa saurica Kotukhov, Bot. Zhurn. (Moscow & Leningrad) 79(7): 103. 1994. *Type:* KAZAKHSTAN. Saur-Tarbagatai, brachia australi-occidentalia jugi Saur, in viciniis hibernaculi Kesek, clivulus saxosus australi-occidentalis, 14.vii.1992, *Kotukhov s.n.* (lectotype, LE!, designated here).

Herbs 31–54 cm tall, perennial, loosely to densely caespitose; branching intravaginal. Culms with three or four nodes, nodes glabrous, usually glabrous, violet or pale; culm internode scabrous or pubescent beneath the node, the remainder glabrous, pubescent or scabrous. Basal leaves 12–30 cm long, green; sheaths minutely pubescent, minutely scabrous, glabrous, papillose or scattered pilose, ciliate, cilia (0.12)0.24–0.47(0.77) mm long; blades 10–25 cm long, (0.37)0.41–0.52(0.68) mm in diameter, convolute or conduplicate, abaxial surface glabrous (sometimes sparsely aculeate at the lower half), adaxial surface minutely pubescent or pubescent, hairs (0.05)0.07–0.10(0.18) mm long; ligules (0.3)0.5–1.2(2.4) mm long, rounded, truncate or lacerate, minutely scabrous or pilose, ciliate, cilia (0.10)0.26–0.41(0.61) mm long. Floriferous culm leaves 10–25 cm long; sheaths 6–21 cm long, scabrous, papillose or glabrous (sometimes scabrous near the apex and the remainder glabrous or papillose), margins glabrous; blades 1–11 cm long, (0.10)0.22–0.38(0.57) mm in diameter, abaxial surface usually glabrous (rarely scabrous or sparsely aculeate), adaxial surface pubescent or minutely pubescent, hairs (0.04)0.05–0.10(0.16) mm long; ligules (0.6)1.3–2.1(3.5) mm long, acute, truncate, lacerate (rarely obtuse), pilose or scabrous, margins ciliate more rarely glabrous, tip ciliate, cilia (0.08)0.15–0.37(0.49) mm long. Panicle (14)16–21(35) cm long, contracted, usually exserted by the upper leaf sheath, four- (three- to six-)noded; basal internode (4.3)8.5–14.1(20.0) cm long, glabrous, scabrous, pilose or scattered pilose; branches (1.4)1.5–2.8(3.9) cm long, erect or erect-spreading, setose, setae (0.21)0.26–0.48(0.64) mm long; basal nodes with one or two branches with one or two spikelets each. Glumes subequal, lanceolate, long acuminate, glabrous, rarely ciliate on the central nerves, cilia 0.16–0.29(0.33) mm long, green and usually purplish tinged, with the margin and tip usually hyaline, lower glume (3.6)3.9–4.6(5.2) cm long and three- to five-nerved, upper glume (3.4)3.7–4.5(4.7) cm long and five- to six- (seven-)nerved. Anthecium (10.1)11.4–12.5(13.9) mm long, (0.80)0.96–1.08(1.13) mm wide, fusiform, coriaceous, pale; lemma (7.7)8.6–9.8(11.0) mm long, near the apex shortly pilose or aculeate, with seven distinct rows of erect-spreading hairs, the ventral row ending (1.0)1.2–1.7(2.6) mm below the top, the dorsal line measuring one-half to four-fifths the length of the lemma, the remaining rows usually shorter than the dorsal one, hairs (0.87)0.91–1.10(1.33) mm long; lemma apex with scattered hairs (rarely with coronula), hairs (0.21)0.34–0.53(1.94) mm long; callus (2.40)2.55–2.98(3.23) mm long, acute, curved, villous, hairs (1.70)1.90–2.29(2.38) mm long on the ventral face and (0.87)1.09–1.45(1.84) mm long on the dorsal face, scar elliptic or circular, peripheral ring (0.70)0.76–0.86(0.93) mm long, (0.20)0.22–0.24(0.28) mm wide [ratio width/length = (0.21)0.25–0.33(0.37)]; palea (8.2)8.7–9.8(10.9) mm long, lanceolate, membranous, margins and tip hyaline, dorsally two-nerved, papillose or glabrous, with the margin and tips glabrous, eventually with a dorsal line of hairs up to one-half of the length of the palea, pale; lodicules three, equal or subequal, acute, lanceolate or linear-lanceolate, hyaline, usually glabrous, dorsal lodicules (1.92)2.39–3.03(3.22) mm long, ventral lodicule (1.53)1.95–2.48(2.96) mm long. Awn (12.4)14.1–16.1(17.5) cm long, unigeniculate or slightly bigeniculate; column (2.3)3.2–3.6(4.5) cm long, base (0.37)0.48–0.55(0.6) mm in diameter, twisted, pale, brown and also with purple stains, usually scabrous (rarely glabrous at the base and the remainder scabrous, sometimes with scattered hairs below the geniculation); seta (8.7)10.4–12.6(13.1) cm long, [ratio column length/seta length = (0.18)0.21–0.35(0.37)], falcate, plumose, hairs in lower part (3.58)4.69–5.50(6.38) mm long. Anthers (4.0)5.6.7(7.4) mm long, with scattered hairs at the apex (rarely glabrous). Ovary glabrous, styles two. Caryopsis unknown (Figs 17, 22C, D).

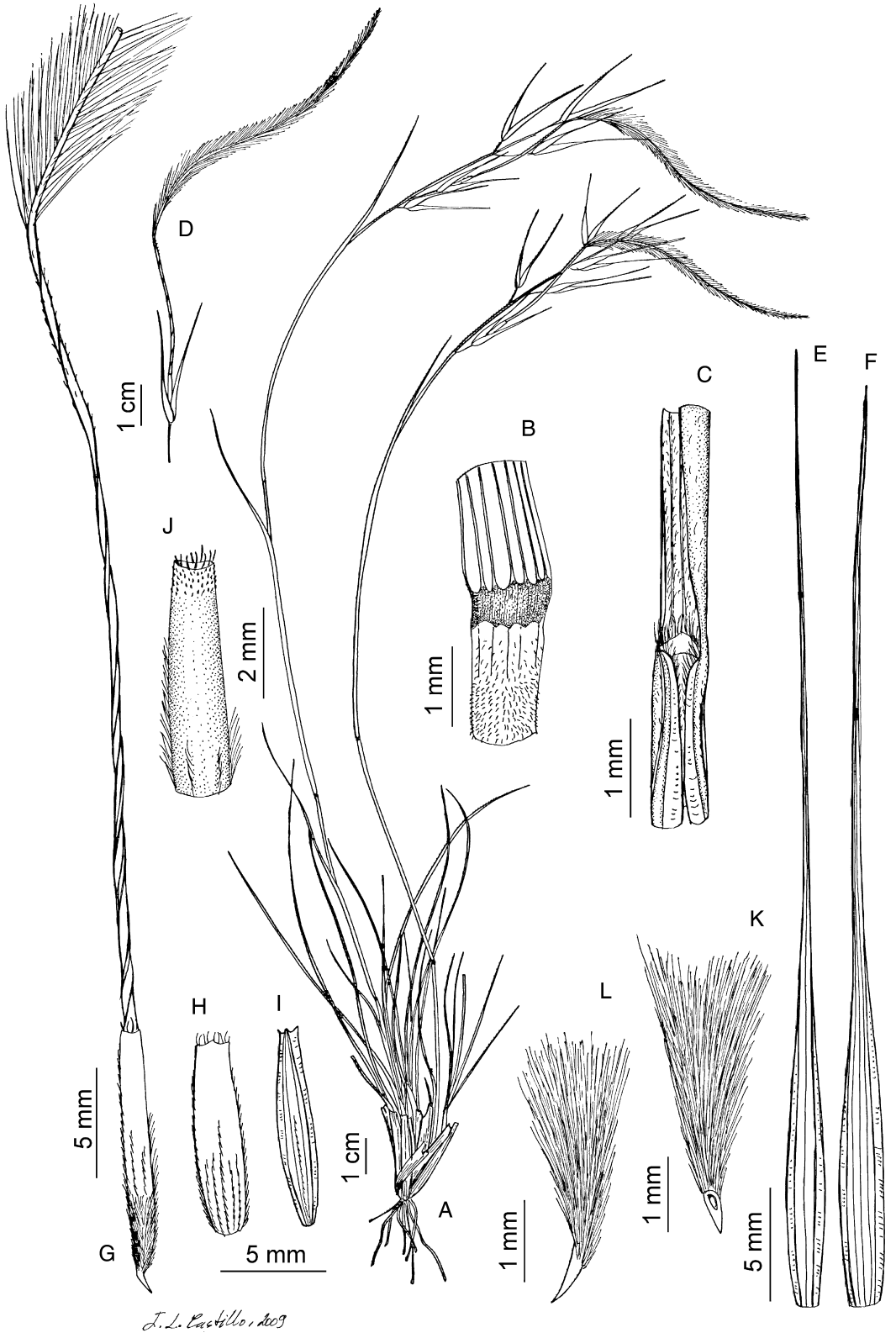

Figure 17. *Stipa alaica*: A, habit; B, floriferous culm node; C, ligule; D, spikelet; E, upper glume; F, lower glume; G, anthecium and column; H, lemma; I, palea; J, lemma apex (coronula); K, callus, ventral view; L, callus, lateral view. [Based on: *Kotukhov* 17.vii.1993 (LE) sub *S. saurica*.]

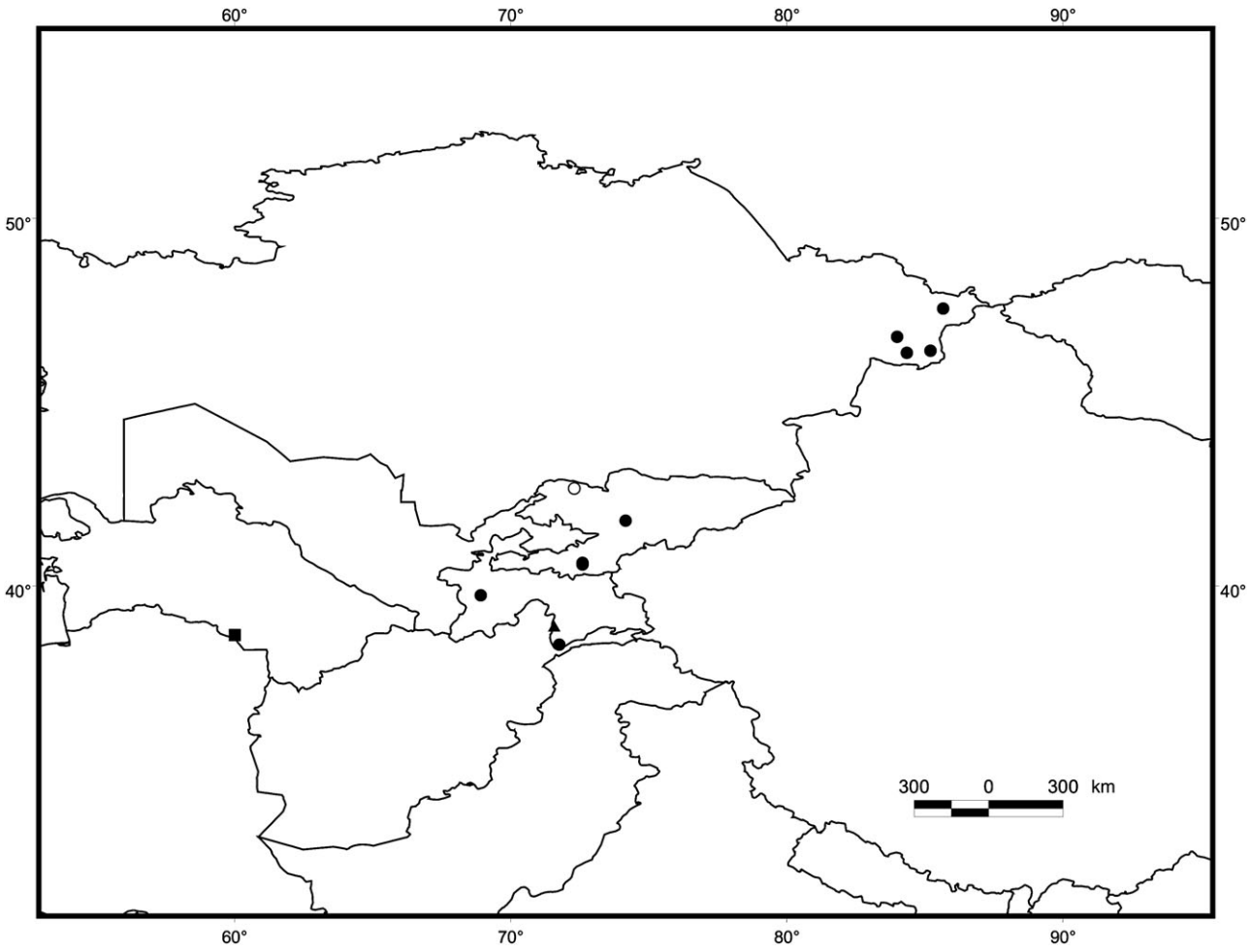

Figure 18. Distribution map: ●, *Stipa alaica*; ○, *S. talassica*; ▲, *S. okmirii*; ■, *S. kopetdaghensis*.

Chromosome number: Unknown.

Habitat and distribution: Inhabits rocky slopes and steppes of middle and high mountains. From the Pamir, the Alai mountains, southern Tien Shan and eastern Kazakhstan; 1000–3300 m (Fig. 18).

Phenology: Flowers and fruits from June to August.

Representative specimens examined: KAZAKHSTAN. EAST KAZAKHSTAN: Jugi Manrak pars centralis, locus Sagyndyk Majo, 47°25′N, 84°20′E, 27.vi.1986, *Kotukhov s.n.* (LE); Saur-Tarbagatai. NO Saykan, 47°30′N, 85°12′E, 16.vii.1993, *Kotukhov s.n.* (LE); Saur-Tarbagatai. NW Saur range, Kensay forest, 48°00′N, 84°00′E, 14.vii.1992, *Kotukhov s.n.* (LE); Saur-Tarbagatai. NW Saur range, Kiziltas forest, 49°01′N, 85°39′E, 17.vii.1993, *Kotukhov s.n.* (LE). TAJIKISTAN. GORDON-BADAKHSHAN: west Pamir, Vakhan-Ishkashimskii District, eastern hillsides to Abkharv river between Shenade and Dibane, 36°49′N, 71°34′E, 30.vi.1935, *Ovzcinnikov* & *Afanasiev 832* (LE); Vakhan-Ishkashimskii District, at western slope of Katta-Khorob. Ishkashish, 36°50′N, 71°45′E, 9.vii.1935, *Ovzcinnikov* & *Afanasiev 1024* (LE). KYRGYZSTAN. CHUI: Prov. Semirechenskaya Distr. Przhevalsk. Forest Toguz-Torau. Close to Kargalyk-Pereval pass, 41°17′N, 74°10′E, 9.vi.1913, *Saposhnikow s.n.* (LE). OŠ: east of Sarik-Mogola, 39°55′N, 72°47′E, 17.vi.1961, *S. S. Ikonnikov 12746* (LE).

Notes: Stipa alaica has been considered to be closely related to *S. tianschanica* (Pazij, 1968). Although both species share a similar habitat and distribution, there are clear morphological differences (Pazij, 1968; Tzvelev, 1976), most obviously in the awn being falcate in *S. alaica*, but straight in *S. tianschanica*. *Stipa alaica* also resembles *S. klemenzii* morphologically, which also has a clearly falcate awn, and with the spikelets rather similar in size to those of *S. alaica.* However, in addition to the subbigeniculate awn, *S. alaica* differs by having the

lemma with seven distinct rows of hairs and the lemma apex with scattered hairs. In contrast, *S. klemenzii* has the subdorsal and the lateral rows of hairs fused, and the lemma apex glabrous.

Kotukhov (1989, 1994) described two taxa endemic to east Kazakhstan with sub-bigeniculate awns. In the protologue of *S. manrakika*, Kotukhov mentioned that it was closely allied to *S. alaica*, differentiated by its longer awn (16.3–17.5 cm vs. 12.0–14.0 cm) and by the upper cauline leaf slightly swollen. Subsequently, he described *S. saurica* from the Saur-Tarbagatai, distinguished from *S. caucasica* by its subglabrous column and longer ligules. Unfortunately, Kotukhov did not discuss its similarity with *S. alaica*. The study of the original material did not reveal any substantial differences from *S. alaica*, and we consider that both taxa are better placed as synonyms of *S. alaica*. *Stipa alaica* was originally described as endemic to the Pamir-Alai region and, with the inclusion of the two recent taxa of Kotukhov as synonyms, its known distribution area has been enlarged to the middle mountains of east Kazakhstan.

The material designated as the type of *S. saurica* is mounted on two sheets. However, each sheet has specimens of two different species. One has the awn unigeniculate or sub-bigeniculate, corresponding to the description of *S. saurica*, whereas the other has the awn clearly bigeniculate and has been identified as *S. turkestanica* Hack. Consequently, the specimen identified as *S. saurica* (= *S. alaica*) is designated as the lectotype [ICBN, art. 9.9].

10. Stipa talassica Pazij

Stipa talassica Pazij, Bot. Mater. Gerb. Inst. Bot. Zool. Akad. Nauk. Uzbeksk. S.S.R. 10: 21. 1948. *Type:* KYRGYZSTAN. Tian-Shan. Talaskii region. Talasski Alatau, Bastash river valley, 30.vi.1927, *Sovetkina* & *Uspenskaya 339* (holotype: TAK digital image!; isotype: LE!).

Herbs *c*. 44 cm tall, perennial, caespitose; branching intravaginal. Culms with four nodes, nodes glabrous, with an evident stripe of hairs, violet; culm internode pubescent. Basal leaves *c*. 32 cm long, green; sheaths minutely pubescent, ciliate, cilia 0.40–0.79 mm long; blades 21–26 cm long, 0.50–0.52 mm in diameter, convolute, abaxial surface distinctly scabrous, adaxial surface minutely pubescent, hairs 0.07–0.1 mm long; ligules 0.9–1.7 mm long, rounded, minutely scabrous, ciliate, cilia 0.32–0.40 mm long. Floriferous culm leaves 22–24 cm long; sheaths 13–21 cm long, scabrous or papillose, or scabrous near the apex and the remainder papillose or glabrous, margins glabrous; blades 2–9 cm long, 0.2–0.5 mm in diameter, abaxial surface scabrous in the lower half and the remainder glabrous, adaxial surface pubescent, hairs 0.10–0.15 mm long; ligules (1.7)2.8–4.6(4.9) mm long, acute, scabrous, margin and tip glabrous. Panicle 12–17 cm long, contracted, partially enclosed by the upper leaf sheath, with four nodes; basal internode 5.8–6.6 cm long, scabrous with scattered hairs; branches 2.4–3.1 cm long, erect, setose, setae 0.45–0.53 mm long; basal nodes with two branches with one or two spikelets each. Glumes subequal, lanceolate, long acuminate, glabrous, ciliate on the central nerves, cilia *c*. 0.12 mm long, green with margins and tip hyaline, lower glume 5.5–5.6 cm long and three- to five-nerved, upper glume 5.5–5.6 cm long and five- to seven-nerved. Anthecium 12.6–13.8 mm long, 1.22–1.31 mm wide, fusiform, coriaceous, brown; lemma 10.1–11.0 mm long, near the apex papillose with scattered hairs, with seven distinct rows of erect-spreading hairs, the ventral row of hairs ending 2.1–2.2 mm below the top, the dorsal line measuring one-half to two-thirds of the length of the lemma, the remaining rows slightly shorter than the dorsal one, hairs 1.05–1.23 mm long; lemma apex glabrous or with scattered hairs, hairs *c*. 0.54 mm long; callus 2.5–2.8 mm long, acute, curved, villous, hairs 1.80–1.92 mm long on the ventral face and 1.24–1.38 mm long on the dorsal face, scar elliptic, peripheral ring 0.86–0.89 mm long, 0.28–0.31 mm wide (ratio width/length = 0.31–0.36); palea unknown; lodicules unknown. Awn 19.8–22.0 cm long, unigeniculate or slightly bigeniculate; column 3.60–4.05 cm long, base 0.59–0.62 mm in diameter, twisted, pale, somewhat scabrous and with scattered hairs below the geniculation; seta 15.6–16.7 cm long (ratio column length/seta length = 0.23–0.24), straight or slightly flexuous, flexuous, hairs in lower part 5.2–5.3 mm long. Anther length unknown. Ovary unknown. Caryopsis unknown.

Chromosome number: Unknown.

Habitat and distribution: Inhabits rocky slopes at middle mountain belts. Endemic from Alatau Mountain, northwestern Kyrgyzstan, close to Kazakhstan boundaries (Fig. 18).

Phenology: Flowers in June.

Notes: Stipa talassica shares with *S. lingua* subsp. *lipskyi* and *S. longiplumosa* a straight and long awn with a glabrous or tuberculate column. However, *S. talassica* may be easily distinguished by the presence of basal ligules 0.89–1.70 mm long and seta hairs 5.20–5.31 cm long, whereas *S. lingua* subsp. *lipskyi* and *S. longiplumosa* have ligules up to 0.15 mm long or reduced to a line of hairs, and seta hairs (6.0)7.0–9.5(12.0) mm long.

When Pazij (1948) described *S. talassica*, he pointed out its affinity with *S. lingua* subsp. *lipskyi*

(as *S. lipskyi*) and, in addition to the two features mentioned above, he remarked on its longer column and the absence of a coronula. In addition, we have found differences in the basal blade leaf indument. *Stipa talassica* has a scabrous abaxial surface and short hairs on the adaxial surface, whereas *S. lingua* subsp. *lipskyi* has a glabrous abaxial surface and long hairs on the adaxial surface. Nonetheless, the most similar species morphologically would appear to be *S. longiplumosa*, which shares the features given by Pazij (1968). In addition to the diferences mentioned in the first paragraph, *S. longiplumosa* also differs by having a glabrous column compared with the scabrous column of *S. talassica*.

The type material is from mountains in Kyrgyzstan, close to the border with Kazakhstan. Its presence in Kazakhstan has been upheld by Gamajunov (1956, cited in Pazij, 1968: 75) and Goloskokov (1969). Pazij (1968) indicated that Gamajunov's citation for Kazakhstan was erroneous. Unfortunately, it was not possible to review material other than the type and its presence in Kazakhstan remains to be verified.

11. Stipa gegarkunii P.A.Smirn

Stipa gegarkunii P.A.Smirn., Uchen. Zap. Moskovsk. Gosud. Univ. 2: 333. 1934. *Type:* ARMENIA. Ad lacum Sevan prope pag. Schordsha, 28.vii.1929, *P. Smirnow 48* (lectoype: MW designated by Smirnow, 1970; isolectotypes: B!, C!, E!, ERE!, FI!, H!, JE!, L!, LE!, S!,W!).

Herbs 48–66 cm tall, perennial, densely caespitose; branching intravaginal. Culms with three or four nodes, nodes glabrous (rarely pubescent), brown or violet; culm internode minutely pubescent, scabrous or glabrous. Basal leaves 23–44 cm long, green and pruinose; sheaths glabrous or scattered aculeate (rarely minutely pubescent), ciliate, cilia (0.53)0.60–1.18(1.23) mm long; blades 15–31 cm long, (0.60)0.63–0.80(0.90) mm in diameter, convolute, abaxial surface glabrous, adaxial surface papillose, papillae 0.01–0.02(0.04) mm long; ligules (0.25)0.36–0.47(1.17) mm long, truncate, pilose, ciliate, cilia (0.28)0.42–1.14(1.67) mm long. Floriferous culm leaves 19–32 cm long; sheaths 13–27 cm long, somewhat scabrous or sparsely pilose near the apex and the remainder glabrous, margins glabrous; blades 1.0–9.9 cm long, (0.17)0.32–0.54(0.67) mm in diameter, abaxial surface glabrous or scattered aculeate, adaxial surface papillose, papilla (0.01)0.04–0.20 mm long; ligules (0.60)1.60–3.52(4.72) mm long, irregular, truncate, rounded or acute and usually convolute, pilose (rarely scabrous), ciliate or glabrous, tip ciliate, cilia (0.16)0.31–0.47(0.59) mm long. Panicle (19)24–30(36) cm long, contracted, exserted or partially enclosed by the upper leaf sheath, with (three) five or six nodes; basal internode (3.34)8.50–16.40(20.20) cm long, scabrous (rarely scabrous with scattered hairs); branches (1.6)3.3–3.6(3.8) cm long, erect, setose, setae (0.15)0.25–0.81(1.24) mm long; basal nodes with one or two (three) branches with one (two) spikelet(s) each. Glumes subequal, lanceolate, long acuminate, glabrous, ciliate on the central nerve, cilia (0.05)0.34–0.60(0.70) mm long, green or pale and with purplish tinge, the margins and tips usually hyaline, lower glume (5.4)6.3–7.0(7.7) cm long and five- (to seven-) nerved, upper glume (5.4)5.8–6.5(7.0) cm long and (six-) seven-nerved. Anthecium (16.1)17.1–18.1(19.8) mm long, (1.2)1.3–1.4(1.7) mm wide, fusiform, coriaceous, pale or brown (sometimes slightly purplish tinged); lemma (12.0)13.3–13.7(15.1) mm long, scattered shortly pilose near the apex, with seven distinct rows of erect or erect-spreading hairs, the ventral row reaching the top (rarely ending 0.3 mm below the top), the dorsal one measuring three-quarters to four-fifths the length of the lemma, the remaining rows usually shorter than the dorsal row, hairs (0.68)0.85–0.95(1.27) mm long; lemma apex with scattered hairs (0.21)0.25–0.72(1.04) mm long; callus (3.4)3.9–4.6(5.0) mm long, acute, curved, villous, hairs (2.12)2.40–2.73(2.93) mm long on the ventral face and (1.09)1.21–1.57(1.69) mm long on the dorsal face, scar elliptic, peripheral ring (0.95)1.05–1.15(1.22) mm long, (0.30)0.32–0.35 mm wide [ratio width/length = (0.25)0.26–0.33]; palea 13.3–13.8 mm long, lanceolate, membranous, margins and tip hyaline, dorsally two-nerved, between the two nerves papillose with a dorsal line of hairs up to two-thirds the length of the palea, margins glabrous and tips glabrous or scattered ciliate, pale; lodicules three, equal or subequal, with the dorsal one slightly longer or shorter than the ventral one, acute, lanceolate, membranous, glabrous, dorsal lodicules (3.06)3.18–3.57(3.80) mm long, ventral lodicule (2.79)3.11–3.73(3.90) mm long. Awn (17.6)21.2–27.0(28.4) cm long, unigeniculate or slightly bigeniculate; column (3.3)3.5–4.5(5.2) cm long, base (0.59)0.64–0.75(0.84) mm in diameter, twisted, pale, green and usually with purple stains, scabrous in the base and the remainder scabrous and sparsely pilose; seta (14.3)15.9–21.8(23.0) cm long (ratio column length/seta length = 0.17–0.28), flexuous, plumose, hairs in lower part (4.7)5–5.4(5.7) mm long. Anthers 8.8–9.7 mm long, glabrous or with scattered hairs at the apex, purple. Ovary glabrous, styles two. Caryopsis unknown; embryo unknown (Figs 19, 22E, F).

Additional illustrations: Smirnow (1970: 114, fig. b, d).

Chromosome number: $2n = 44$ (Nazarova & Ghukasyan, 2004).

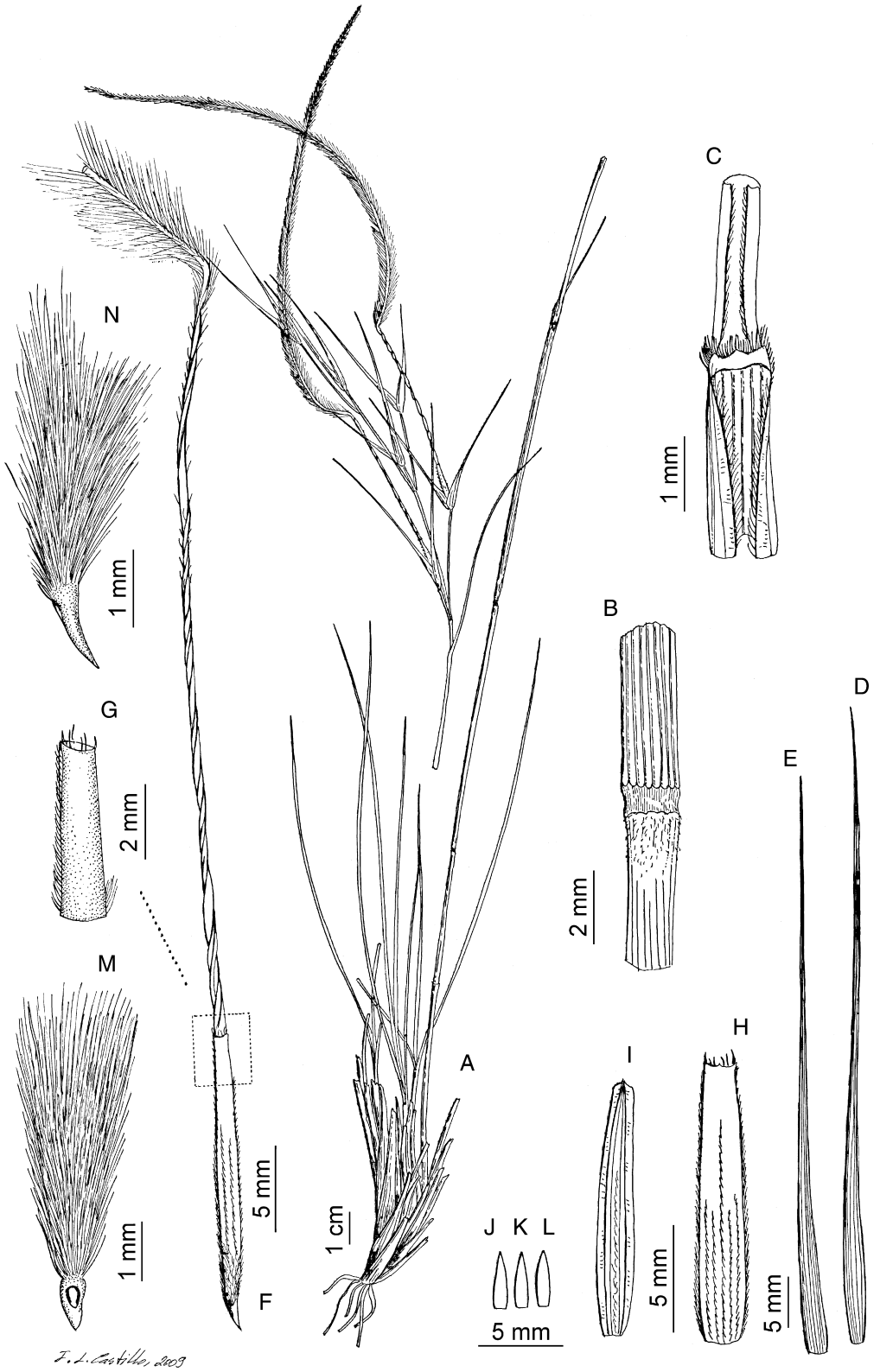

Figure 19. *Stipa gegarkunii*: A, habit; B, floriferous culm node; C, ligule; D, upper glume; E, lower glume; F, anthecium and column; G, lemma apex (coronula); H, lemma; I, palea; J, ventral lodicule; K, L, dorsal lodicules; M, callus, ventral view; N, callus, lateral view. [Based on: *P. Smirnow 48* (S).]

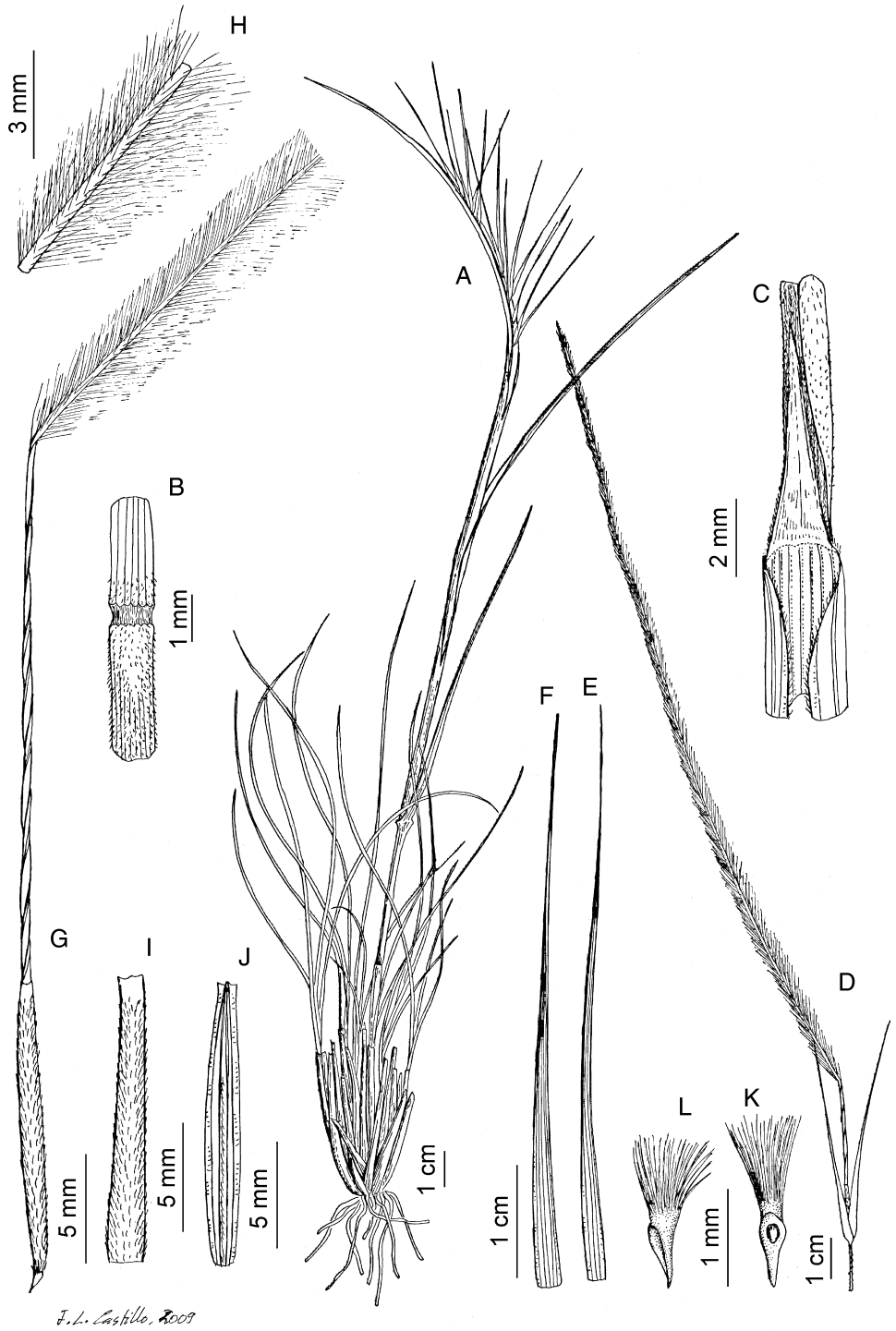

Figure 20. *Stipa gaubae*: A, habit; B, floriferous culm node; C, ligule; D, spikelet; E, upper glume; F, lower glume; G, anthecium and column; H, column in detail (at 1 cm from the base of the column); I, lemma; J, palea; K, callus, ventral view; L, callus, lateral view. [Based on: A–G, I–L, *Takhtajan et al. 131078* (ERE); H, *Gaubae 1632* (K).]

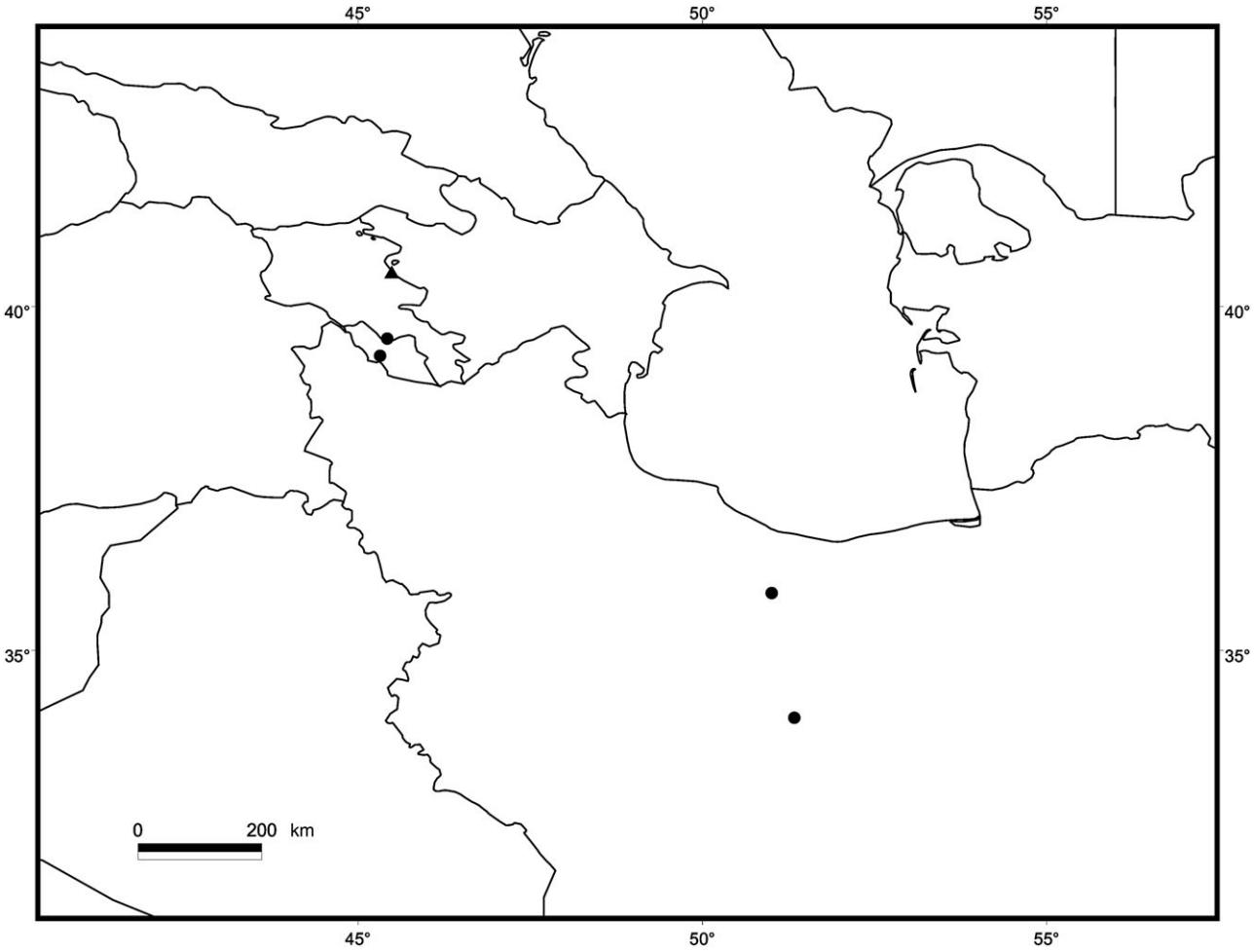

Figure 21. Distribution map: ●, *Stipa gaubae*; ▲, *S. gegarkunii*.

Habitat and distribution: Inhabits rocky slopes in middle mountain belts. Endemic to Armenia (Fig. 21).

Phenology: Flowers in July.

Notes: Stipa gegarkunii may be easily distinguished from the other species of the section by its flexuous seta, its papillose adaxial surface of the basal leaves and, especially, by its longer anthecium. In addition, *S. gegarkunii* shows a sub-bigeniculate awn, but this character is shared with *S. alaica*, *S. talassica*, *S. kopetdaghensis* and *S. okmirii*.

The large size of the anthecium structures and the flexuous awn are similar to section *Stipa*, whereas the presence of scattered hairs at the lemma apex and the presence of a unigeniculate or sub-bigeniculate awn resemble section *Smirnovia*. Probably, this is the reason why Smirnow (1970) and Tzvelev (1976) considered *S. gegarkunii* as a recent hybrid species derived from crossing between *S. pulcherrima* Koch and *S. caucasica*. We agree that it is probably of hybrid origin between *S. caucasica* and *S. pulcherrima* subsp. *epilosa* (Martinovský) Tzvelev, as both taxa overlap in Sevan (Armenia). Further explorations are needed to improve the species description and to clarify its systematic position.

Stipa gegarkunii has been studied only from the type material, but, fortunately, it is a complete collection that includes 11 duplicates. Nazarova & Ghukasyan (2004) provided the chromosome number of a recently collected specimen from 'Aparanskiy district: Sagmosavank-Aparan, 22.vii.2003, *Mankaina s.n.*' identified as *S. gegarkunii*, but we have not seen this voucher.

12. Stipa okmirii Dengub

Stipa okmirii Dengub., Bot. Zhurn. (Moscow & Leningrad) 65: 431. 1980. *Type:* TAJIKISTAN. Schugnan district, close to horti Botanici Pamirensis, 14.vi.1977, *Dengubenko 2731* (holotype: LE!).

Herbs 69–80 cm tall, perennial, caespitose; branching intravaginal. Culms with three nodes, nodes gla-

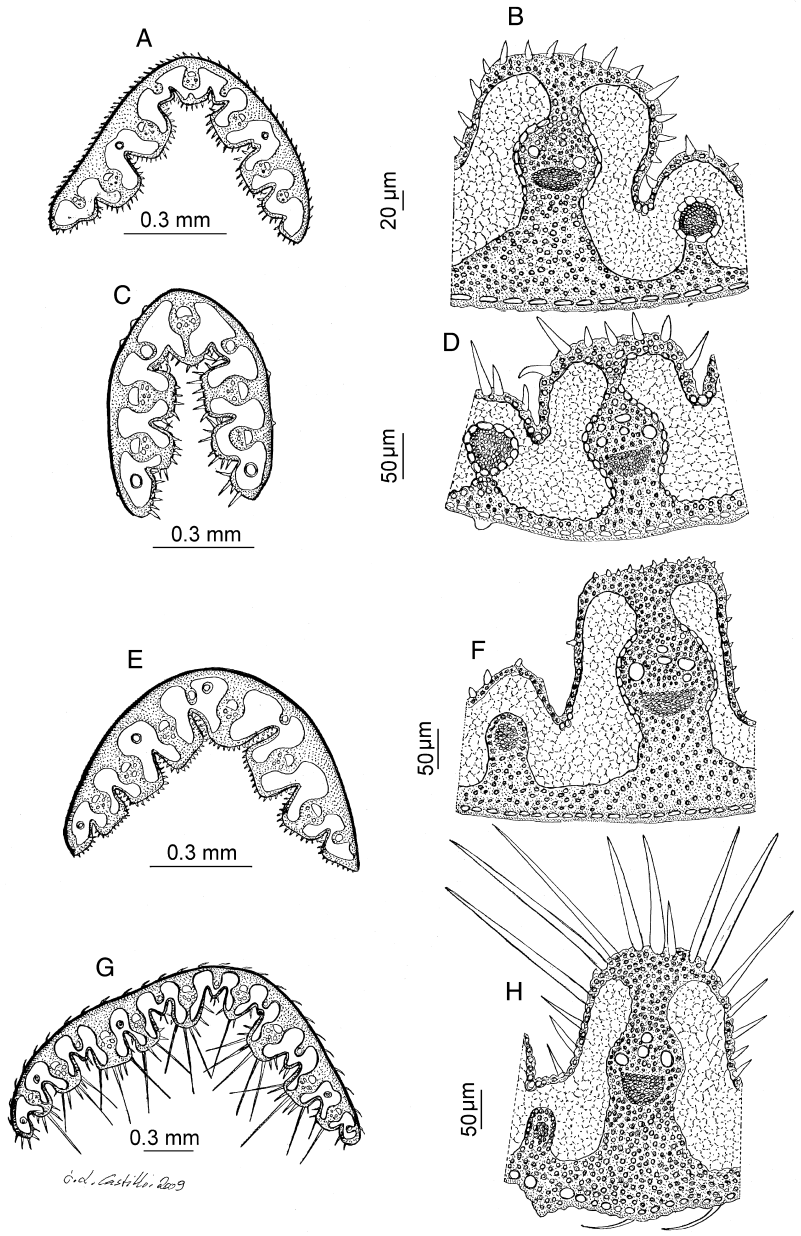

Figure 22. *Stipa longiplumosa*: A, transverse section of leaf blades; B, central nerve of leaf blades. *Stipa alaica*: C, transverse section of leaf blades; D, central nerve of leaf blades. *Stipa gegarkunii*: E, transverse section of leaf blades; F, central nerve of leaf blades. *Stipa gaubae*: G, transverse section of leaf blades; H, central nerve of leaf blades. [Based on: A, B, *Prianishkov 126* (JE); C, D, *Kotukhov* 17.vii.1993 (LE); E, F, *Smirnow 48* (S); G, H, *Takhtajan et al. 131078* (ERE).]

brous, violet; culm internode scabrous beneath the node, the remainder pilose. Basal leaves 35–43 cm long, green; sheaths scabrous, ciliate, cilia 0.35–0.58 mm long; blades 23–28 cm long, 0.50–0.77 mm in diameter, convolute, abaxial surface distinctly scabrous, adaxial surface pubescent, hairs 0.39–0.50 mm long; ligules 0.50–0.65 mm long, rounded, minutely scabrous, ciliate, cilia 0.32–0.43 mm long. Floriferous culm leaves 24–41 cm long; sheaths 16–31 cm long, scabrous or papillose, margins glabrous; blades 7.4–11.0 cm long, 0.39–0.43(0.46) mm in diameter, abaxial surface scabrous or scattered aculeate, adaxial surface pubescent, hairs (0.18)0.21–0.36(0.40) mm long; ligules (1.87)2.18–3.00(3.19) mm long, rounded or obtuse, scabrous, ciliate, cilia (0.11)0.14–0.22(0.24) mm long. Panicle 49.0–56.5 cm long, contracted, exserted from the upper leaf sheath, with five or six nodes; basal internode 32.4–38.3 cm long, sca-

brous and pilose; branches 3.2–6.0 cm long, erect, setose, setae 0.38–0.45 mm long; basal nodes with two branches with one or two spikelets each. Glumes equal, lanceolate, long acuminate, glabrous, rarely ciliate on the central nerves, cilia *c*. 0.29 mm long, green with margins and tip hyaline and with purple stains, lower glume 6.1–6.8 cm long and three- to five-nerved, upper glume 6.0–6.7 cm long and five- to seven-nerved. Anthecium 13.8–15.5 mm long, 1.16–1.28 mm wide, fusiform, coriaceous, green; lemma 11.3–12.8 mm long, near the apex shortly aculeate, with seven distinct rows of erect-spreading hairs, the ventral row ending 2.04–2.46 mm below the top, the dorsal line measuring three-quarters the length of the lemma, the remaining rows measuring one-half of the length of the lemma, hairs 0.90–1.17 mm long; coronula, hairs 0.49–1.45 mm long; callus 2.5–2.7 mm long, acute, curved, villous, hairs 2.55–2.70 mm long on the ventral face and 1.43–1.69 mm long on the dorsal face, scar ± elliptic, peripheral ring 1.00–1.07 mm long, 0.41–0.45 mm wide (ratio width/length = 0.41–0.42); palea 11.6–11.9 mm long, lanceolate, membranous, margins and tip hyaline, dorsally two-nerved, between the two nerves papillose or glabrous, margins glabrous and tip ciliate, green; lodicules three, subequal, acute, lanceolate, hyaline, glabrous, dorsal lodicules 3.27–3.43 mm long, ventral lodicule 2.51–2.69 mm long. Awn 22.4–24.5 cm long, unigeniculate or slightly bigeniculate; column 4.2–4.5 cm long, base 0.41–0.45 mm in diameter, twisted, green, green, pale and with purple stains, somewhat scabrous and with scattered hairs below the geniculation; seta 17.6–19.8 cm long (ratio column length/seta length = 0.21–0.25), flexuous or slighly straight, plumose, hairs in lower part 5.5–6.74 mm long. Anthers 7.0–9.3 mm long, glabrous, purple. Ovary glabrous, styles two. Caryopsis unknown.

Chromosome number: Unknown.

Habitat and distribution: Inhabits rocky slopes of middle mountains. Endemic to Shugnan region in Pamir (Tajikistan) (Fig. 18).

Phenology: Flowers in June.

Notes: Stipa okmirii is known only from the type collection. It is one of the most singular taxa of the group, characterized by the combination of sub-bigeniculate awns, lemma with coronula, and basal leaves with a scabrous abaxial surface and pubescent adaxial surface. Another useful character is its long and flexuous awn, elsewhere seen in *S. gegarkunii*, from which it is easily distinguished by the other features mentioned above. After a careful examination of the original material, we noticed the presence of unigeniculate awns and slightly bigeniculate awns on the same voucher. Future explorations are needed to collect more specimens and to improve the description and its relationship with other species of the section.

13. Stipa kopetdaghensis Czopanov

Stipa kopetdaghensis Czopanov, Novosti Sist. Vyssh. Rast. 6: 22 (1970). *Type:* TURKMENISTAN. Montes Kopetdagh centralis, in declivitate occidentali prope apicem montis Dushak in solo argilloso, 30.vii.1967, *Czopanov s.n.* (holotype: ASH; isotype: LE!).

Herbs 47–55 cm tall, perennial, caespitose; branching intravaginal. Culms with three or four nodes, nodes pubescent, with an evident stripe of hairs, violet; culm internode pubescent. Basal leaves 33–50 cm long, green; sheaths minutely pubescent, ciliate, cilia *c*. 0.95 mm long; blades 26–30 cm long, 0.54–0.62 mm in diameter, convolute, abaxial surface distinctly scabrous, adaxial surface pubescent, hairs 0.14–0.20 mm long; ligules 0.7–1.1 mm long, rounded, minutely pubescent, ciliate, cilia 0.40–0.69 mm long. Floriferous culm leaves 14–25 cm long; sheaths 9–21 cm long, papillose, or papillose near the apex and the remainder glabrous, margins glabrous; blades 4–11 cm long, (0.29)0.30–0.39(0.43) mm in diameter, abaxial surface scabrous, adaxial surface pubescent, hairs (0.12)0.13–0.16(0.17) mm long; ligules (2.5)2.9–4.8(5.3) mm long, acute, scabrous, margins glabrous and tip ciliate, cilia 0.17–0.26 mm long. Panicle 12–30 cm long, contracted, partially enclosed by the upper leaf sheath, with three or four nodes; basal internode 12.8–13.1 cm long, scabrous; branches 2.8–4.9 cm long, erect or erect-spreading, setose, setae 0.30–0.45 mm long; basal nodes with two branches with one or two spikelets each. Glumes subequal, lanceolate, long acuminate, glabrous, ciliate on the central nerves, cilia *c*. 0.51 mm long, green with purple stains, margins and tip hyaline, lower glume 5.0–5.3 cm long and five-nerved, upper glume 4.9–5.2 cm long and seven-nerved. Anthecium 13.0–14.4 mm long, 0.98–1.18 mm wide, fusiform, slightly laterally compressed, coriaceous, pale; lemma 10.3–11.7 mm long, near the apex minutely aculeate, with seven distinct rows of erect hairs, the ventral row ending 1.17–1.85 mm below the top, the dorsal row measuring one-half to three-quarters the length of the lemma, the remaining rows usually longer than the dorsal one, hairs 0.65–0.76 mm long; coronula or with scattered hairs, hairs 0.19–0.52 mm long; callus 2.6–3.1 mm long, acute, curved, villous, hairs 1.67–2.41 mm long on the ventral face and 1.10–1.79 mm long on the dorsal face, scar elliptic, peripheral ring 0.85–0.91 mm long, 0.25–0.28 mm wide (ratio width/length = 0.29–0.32); palea *c*. 10.89 mm long, lanceolate, membranous, margins and tip hyaline,

dorsally two-nerved, between the two nerves papillose or glabrous, margins glabrous and tip ciliate, pale; lodicules three, subequal, acute, lanceolate, hyaline, glabrous, dorsal lodicules *c*. 1.55 mm long, ventral lodicule *c*. 1.52 mm long. Awn 11–17 cm long, unigeniculate or slightly bigeniculate; column 4.3–4.7 cm long, base 0.52–0.54 mm in diameter, twisted, pale, somewhat scabrous and with scattered hairs below the geniculation; seta 11.0–12.5 cm long (ratio column length/seta length = 0.37–0.40), falcate, plumose, hairs in lower part 5.01–7.08 mm long. Anthers *c*. 7.13 mm long, with scattered hairs, yellow. Ovary glabrous, styles two. Caryopsis unknown.

Chromosome number: Unknown.

Habitat and distribution: Inhabits arid rocky and sandy slopes. Endemic to Kopet Dagh range (Turkmenistan); 200–1000 m.

Phenology: Flowers and fruits from June to July.

Notes: This species may be distinguished by the combination of its falcate awn and glabrous column. These characters are shared with *S. alaica* and *S. klemenzii*. However, *S. kopetdaghensis* may be distinguished from both by its sub-bigeniculate awn, its scabrous abaxial surface of the basal leaves and its longer anthecium and column. *Stipa alaica* and *S. klemenzii* exhibit unigeniculate awns, the abaxial side of the basal leaves is glabrous and the anthecium and column are shorter.

According to Czopanov (1970), this species is close to *S. turkestanica* Hack. and *S. trichoides* P.A.Smirn., from which it may be distinguished by its unigeniculate to sub-bigeniculate awn and the presence of a coronula at the top of the lemma. The awn geniculation is not a reliable diagnostic feature because, in *S. turkestanica* and *S. trichoides*, the lower geniculation is indistinct at the early stages of development. Nonetheless, the specimen of *S. kopetdaghensis* studied has well-developed shoots and exhibits indistinctly unigeniculate or sub-bigeniculate awns (Czopanov, 1970). In addition, the ligule is similar in size to that of *S. trichoides*, but is much shorter than that of *S. turkestanica* (2.5–7.0 mm vs. 0.7–1.1 mm). However, the anthecium and the awn are similar in size to those of *S. turkestanica* and much longer than those of *S. trichoides*. Another feature that may assist in distinguishing *S. kopetdaghensis* is the falcate awn (usually flexuous in *S. trichoides* and *S. turkestanica*).

Tzvelev (1976) suggested the possibility of its hybrid origin from *S. caucasica* and *S. zalesskii* subsp. *turcomanica* (P.A.Smirn.) Tzvelev. Additional work is needed to clarify the systematic position of the species exhibiting indistinctly unigeniculate or sub-bigeniculate awns.

Section II. *Subsmirnovia* Tzvelev

Section *Subsmirnovia* Tzvelev, Bot. Zhurn. (Moscow & Leningrad) 78: 94. 1993. *Type: S. gaubae* Bor.

Herbs densely caespitose, perennial; branching intravaginal. Culms with two to four nodes, erect. Basal leaves convolute, more rarely plane; ligules acute, lanceolate, more rarely lacerate. Panicle contracted, with the branches usually erect or erect-spreading. Glumes equal or subequal, lanceolate, long acuminate, three- to five-nerved. Anthecium coriaceous, fusiform or laterally compressed; lemma completely covered by dense and soft antrorse hairs; lemma apex glabrous; callus acute, curved, villous, scar broadly elliptic to circular, peripheral ring dorsally flattened and protruding. Palea, lanceolate, two-nerved and equalling or slightly shorter than the lemma; lodicules three, equal or subequal, acute, hyaline, lanceolate or linear-lanceolate. Awn unigeniculate; columns glabrous; seta straight. Ovary glabrous, styles three.

14. Stipa gaubae Bor

Stipa gaubae Bor in K. H. Rechinger (ed.), Fl. Iran. 70: 388. 1970. *Type:* Iran. Qazvin, Ravandeh prope Karaj, *Gauba 1632* (holotype: W!; isotypes: K!, IRAN, THE, THR).

Stipa nachiczevanica Mussajev & Sadychov, Novosti Sist. Vyssh. Rast. 14: 4. 1977. *Type:* Azerbaijan. Republica autonoma Nachiczevan, in viciniis opp. Nachiczevan, Duzdag, 23.vi.1973, *Musajev & Sadychov s.n.* (holotype: BAK; isotype: LE!).

Herbs 51–62 cm tall, perennial, densely caespitose; branching intravaginal. Culms with three nodes, nodes pubescent, pilose above the node, violet; culm internode pubescent. Basal leaves 15–32 cm long, green; sheaths minutely pubescent, ciliate, cilia (0.20)0.24–0.40(0.50) mm long; blades 11–23 cm long, (0.65)0.68–0.92(1.00) mm in diameter, convolute or conduplicate, abaxial surface distinctly scabrous (sometimes pubescent at the lower half), adaxial surface pubescent, hairs (0.27)0.34–0.44(0.45) mm long; ligules (1.6)3.0–4.0(12.3) mm long, lanceolate, rounded or acute, pilose, ciliate, cilia (0.13)0.15–0.25(0.26) mm long. Floriferous culm leaves 21–41 cm long; sheaths 12–33 cm long, pubescent or scattered pilose, ciliate; blades 8–17 cm long, (2.4)2.6–3–4(3.5) mm wide or (0.7)0.8–1.0 mm in diameter, abaxial surface glabrous or scabrous, adaxial surface pubescent with hairs (0.27)0.30–0.40(0.42) mm long; ligules (6.3)7.4–12.9(17.4) mm long, lanceolate, glabrous, papillose or pilose near the blade, margins

glabrous or ciliate with cilia 0.38–0.80 mm long. Panicle 36–42 cm long, contracted, partially enclosed by the upper leaf sheath, with five to seven nodes; basal internode 13–19 cm long, pilose; branches 4.2–6.5 cm long, erect, setose, setae (0.36)0.45–0.64 mm long; basal nodes with two branches with one or two spikelets each. Glumes equal or subequal, lanceolate, long acumintae, glabrous, ciliate on the central nerves, cilia (0.45)0.75–1.05(1.12) mm long, green with margins and tip hyaline, ocasionally with purple stains, lower glume (4.1)4.3–5.5(5.7) cm long and three- to five-nerved, upper glume (4.0)4.1–5.4(5.7) cm long and five- to seven-nerved. Anthecium (12.4)13.7–14.2(14.5) mm long, 0.89–0.91(0.98) mm wide, fusiform, coriaceous, pale; lemma (11.2)12.3–12.8 mm long, densely hairy covered up to 0.91–4.74 mm below the top, eventually with ventral rows reaching the top with erect or apressed hairs 0.42–0.48(0.52) mm long; lemma apex glabrous; callus (1.20)1.37–1.50(1.80) mm long, acute, curved, villous, hairs (0.65)0.68–0.71(0.90) mm long on the ventral face and (0.40)0.45–0.57 mm long on the dorsal face, scar circular or ± elliptic, peripheral ring (0.54)0.66–0.73(0.76) mm long, (0.23)0.25–0.26 mm wide (ratio width/length = 0.34–0.46); palea 10.5–11.9 mm long, lanceolate, membranous, margins and tip hyaline, dorsally two-nerved, margins glabrous and tip ciliate, with a dorsal line of hairs, up to three-quarters the length of the palea, pale; lodicules three, subequal, acute, lanceolate, hyaline, glabrous, dorsal lodicules 1.3–1.9 mm long, ventral lodicule 1.6–2.1 mm long. Awn (15.9)19.8–26.0 cm long, unigeniculate; column (2.1)2.3–2.8(2.9) cm long, base (0.33)0.34–0.41(0.42) mm in diameter, twisted, brown with purple stains or pale, glabrous; seta (13.8)17.3–23.0 cm long (ratio column length/seta length = 0.12–0.15), straight, plumose, hairs in lower part (2.6)2.9–3.6(3.7) mm long. Anthers *c.* 7.1 mm long, glabrous, yellow. Ovary glabrous, styles three. Caryopsis unknown (Figs 20, 22G, H).

Chromosome number: Unknown.

Habitat and distribution: Inhabits lowlands to low mountain belts on gypsaceous soils. Restricted to a small area from Karaj (Iran) to Aznaberd (Azerbaijan); 900–1700 m (Fig. 21).

Phenology: Flowers and fruits from June to July.

Representative specimens examined: AZERBAIJAN: NAXÇIVAN: near Aznaberd, 39°32′N, 45°25′E, 1.vi.1960, *Takhtajan & al. 131078* (ERE).

Notes: Stipa gaubae is a rare species, known only from the type material and an additional locality near Aznaberd and Teheran (Freitag, 1985).

Stipa gaubae was originally placed under series *Brevigeniculatae*, characterized by its unigeniculate and plumose awn. Freitag (1985) indicated some additional characters, such as the long and lanceolate ligules and the ovary with three styles. These features suggest a close relationship to section *Barbatae*. *Stipa gaubae* holds a somewhat isolated systematic position, between section *Smirnovia* and section *Barbatae*. Therefore, and according to Tzvelev (1993), we consider *S. gaubae* better placed as the monospecific section *Subsminrovia*, probably more closely related to section *Smirnovia*.

When Mussajev & Sadychov (1977) described *S. nachiczevanica*, they did not compare it with *S. gaubae*. In our study, no differences were found between these taxa. In accordance with Tzvelev (2006), *S. nachiczevanica* is considered here as a synonym of *S. gaubae*.

EXCLUDED NAMES

Stipa androssowi Litv. ex Roshev. in B.P. Fedtschenko (ed.), Fl. Aziat. Ross. 12: 159. 1916, nom. inval., pro. syn.

Stipa bella var. *incana* Korol. in P.N. Ovczinnikov. Fl. Tadzhiksk. 1: 421. 1957. nom. inval. [ICBN, Art. 36.1].

Stipa caucasica f. *breviaristata* Roshev. in B.P. Fedtschenko (ed.), Fl. Aziat. Ross. 12: 143. 1916. Type: No original material found.

Stipa caucasica f. *crassifolia-autumnalis* Roshev, in sched., nom. nud.

Stipa caucasica f. *dasyphylla* Roshev. in B.P. Fedtschenko (ed.), Fl. Aziat. Ross. 12: 142 (1916). Type: No original material found.

Stipa caucasica var. *tranzschelii* Drobow, Repert. Spec. Nov. Regni Veg. 21: 37. 1925. Type: UZBEKISTAN. Fergana. Distr. Osch. Close to Gulcza village, 1899, *Tranzschel s.n.* (type: No original material found).

Stipa deserti Popov. ex Roshev. in V.L. Komarov (ed.), Fl. URSS 2: 85. 1934, nom. inval., pro syn.

Stipa drakeana Franch. ex Roshev., Bot. Mater. Gerb. Glavn. Bot. Sada S.S.S.R. 5: 13. 1924. nom. inval., pro. syn.

Stipa karatavica B. Fedtsch., Izv. Imp. Bot. Sada Petra Velikago. 14(Suppl. 2): 48. 1914, var. orth. [error for *S. karataviensis*].

Stipa lessingiana var. *karatavica* Hack. in A. Regel. Iter Turkestanicum.1876, in sched. nom. nud.

Stipa orientalis var. *coleantha*Trautv., in sched., nom. nud.

Stipa orientalis var. *humilior* Kryl., Fl. Zap. Sib. 2: 168 1928. Type: Unknown.
Stipa vachanorum Ovcz. in 1994, in sched, nom. nud.

ACKNOWLEDGEMENTS

The authors wish to thank the staff of the cited herbaria for their support of their visits and/or loan of material. They are also indebted to Félix Muñoz Garmendia for his authoritative advice on nomenclature, to Dr Marina Olonova and Marcin Nobis for the digital images provided, to Gregori Lacov for Russian translation, and to two anonymous reviewers for their advice and suggestions on the manuscript. This work was supported by the *Flora Iberica* project CGL2008-02982-C03-01 CLI, Ministerio de Educación y Ciencia, Spain. The authors' visit to the W herbarium was funded by the FPVI European-funded Integrated Infrastructure Initiative grant SYNTHESYS.

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APPENDIX

Index to numbered collections cited. The numbers in parentheses refer to the corresponding species in the text.

Abolin 2989 (1b). *Afanasiev 587* (1a), *809* (1a). *Aitchinson 1137* (4a). *Akhani 9508* (1a), *10511* (1c), *10555* (1a), *10753* (1c), *10858* (1c), *10894* (1c), *10928* (1c). *Alava & Iranshahr 10961* (1a). *Alexeenko 1422* (4c), *2131* (1a), 12.v.1901 (1a), 27.vi.1901 (1a), 28.vi.1901 (4c). *Anders 10834* (4a). *Androsova 79* (5). *Antonow* 30.v.1889 (4a). *Azemsha & Gorevskaia* 9.vii.1953 (1b). *Banzrach, Bannikova, Karamisheva & Mambazar* 25.vi.1972 (2). *Barivtseva* 23.vii.1945 (1b). *Bochantsev 31* (3), *351* (3), *536* (4). *Bochantsev & Egorova 17* (4b). *Bochantsev & Kamelin 483* (4b). *Bosshard* 8.vii.1927 (1b). *Bronevsky 61a* (1a). *Brotherus 148* (1b). *Chaney 80* (1b, 2). *Czopanov & Nepli* (1a). *Czopanov* 29.v.1958 (4a), 30.vii.1967 (13). *Chukavina 676* (8). *Coll. JJ.* 1861 (1b). *Coll. Rév. P.L. de Smed* 1923 (6b). *Cowday 1519D* (6b). *Čuba* 22.vi.1987 (1a). *Czestnaja* 27.vi.1948 (4a). *Dashniam* 25.vii.1956 (7). *Davliashov & Akulishiva 457* (1a). *Dengubenko 2731* (12). *Desiatkin* 29.vi.1928 (1a). *Dessiatoff 610* (1a, 1c), *1251* (1a), *1948* (1a), *2153* (1a), *2186* (1a). *Dickoré 18256* (1b). *Dingel* 25.v.1917 (5). *Drobow 270* (1a), *285* (1c), *809* (1a), *842* (1a), 1.vi.1929 (1c), 3.vii.1929 (1a). *Dürbye 1684* (1b). *Egorova 2187* (1a). *Elias, Weber, Tom & Krasnoborov 4675* (1b). *Elias & Smirnov 90* (1b). *Eriksson 696* (7), *887* (6b). *O. Fedtschenko 28* (1b), 16.vi.1870 (1c). *B. A. Fedtschenko 75* (1a), *364* (1a), *540* (1a). *Fetissow* 5.viii. (1a). *Filatov 219* (3). *Freitag 15.176* (1c). *Gaubae 1632* (14). *Gilli 413* (4a). *Goloskokov* 28.v.1955 (1a), 29.v.1955 (1a), 3.vi.1955 (1a), 15.vi.1955 (1a), 22.v.1959 (1a), 18.vi.1959 (1a), 26.v.1963 (5). *Golubkova, Tsogin & Tsatsegina 116* (7). *Gontscharov 94* (8). *Gontscharov, Grigorjev & V. A. Nikitin 227* (8). *Gordienko & Chilikina 453* (1a). *Gordjagin 3374a* (1a), *3374b* (1a). *Gorelova 3* (4a). *Grubov* 11.vi.1960 (1a), 22.vi.1960 (1a), 27.viii.1982 (1b). *Grubov, Kurbambekov & Yunysov* 13.vii.1964 (4a). *Grubov & Popova* 1.viii.1982 (6a). *Grubov, Ulziijutag & Darshima* 21.vi.1971 (7). *Grubov, Ulziijutag, Dolgotkov & Tsetsegmaia 1179* (2). *Grubov, Ulziijutag & Tsereibaljid* 16.vii.1970 (7). *Grubov, Ulziychutag & Tserenbalzid 191* (6b). *Gubanov 5831* (7b). *Gubanov & Vlasov* 11.viii.1962 (1b). *Huss 206* (1a), *207* (1a). *Hummel 1091* (6b), *1186* (6b), 5.vii.1927 (7). *Igolkin 69* (1a), *134* (1a), *161* (1a), *234a* (1a), *283* (1a). *S. S. Ikonnikov 3979* (1b), *5654* (1a), *12746* (9), *14575* (1a), *14855* (1b). *S. S. Ikonnikov & Ladigina 14797* (1b), *14800* (1b), *1767* (6a). *S. S. Ikonnikov, Ladigina & Litvinova 8748* (1a). *N. Ikonnikov-Galitzky & V. Ikonnikov-Galitzky 3777* (1b). *Iltis et al. 256* (1a). *Isachenko & Rachkovskai* 15.vii.1971 (2). *Ivanov* 1959 (7). *Janminchun & Gavrilenko 673* (1b). *Jarmolenko & Firsv 404* (1a). *Jolinina* 23.vii.1937 (1b), 16.vi.1941 (7). *Junatov 145* (7), *365* (2), *366* (2), *368* (2), *370* (2), *372* (2), *747* (2), *748* (2), *754* (2), *876* (1a), *1347* (1b), *2737* (1b), *2769* (1b, 2), *2771* (2), *2773* (2), *3115* (2), *3119* (2), *3120* (2), *3130* (2), *3177* (2), *4100* (2), *4600* (2), 24.ix.1940 (1b, 6b), 10.x.1940 (7), 28.x.1940 (7), 7.vi.1941 (6b), 14.vi.1941 (6b), 16.vi.1941 (2), 27.vi.1941 (6b), 17.vii.1943, 22.vii.1943 (7), 22.vii.1943 (1b), 28.vii.1943 (6b), 11.viii.1943 (6b), 16.viii.1943 (6b), 26.viii.1943 (6a), 18.ix.1943 (6b), 18.ix.1943 (7), 23.viii.1944 (1b), 28.viii.1944 (6b), 4.viii.1945 (7), 18.vii.1949 (7), 14.viii.1949 (7), 11.viii.1950 (7). *Junatov & Fen 550* (1a), *603* (1b), *704* (6a), *786* (6a), *823* (1b), *847* (6a), *852* (6a), *892* (6a), 21.v.1957 (6b). *Junatov & Kuznetsov* 26.vii.1956 (1a). *Kalinina* 14.vii.1937 (1b), 23.vii.1937 (1b), 19.vii.1950 (7), 11.viii.1950 (7), 10.vi.1951 (7). *Kalinina, Dova-Jamts & Ochir* 18.vi.1948 (7). *Kalinina, Sokolova & Schischkin*; 10.viii.1936 (1b). *Kalinnikov* 19.vii.1950 (6b). *Kamelin 183* (1a), *348* (1a). *Kamelin, Mijailova, Mishonkova, Safronova & Soloviev 472* (3), *607* (3), *934* (1a), *1137* (5), *1255* (5), *1394* (5). *Karelin & Kiriloff 1841* (1b). *Kazantseva* 22.vi.1974 (6b). *Keideman* 27.v.1932 (1c). *Klemenz 72a* (7). *Knorring 118* (1a), *283* (5), 15.vii.1908 (5), 13.vii.1914 (1a). *Knorring & Emme 164* (1a). *Koelz 2342a* (1b). *Komarov* 4.vii.1914 (1a). *Korshinsky 5637* (1b), *5640* (1b), *5642* (1b), *5655* (1a). *Kotov 500* (1a). *Kotukhov* 27.vi.1986 (9), 16.vii.1993 (9), 14.vii.1992 (9), 17.vii.1993 (9). *Kozlova 144* (4b), *35* (4b). *Krascheninnikov 139* (1a), *5003* (4b). *Krylov* 17.vii.1903 (1b). *Kudriashev 1635* (1a). *Kurganskaia, Kojevnikova, Udintseva* 1.viii.1960 (1a), 7.viii.1960 (1b). *Ladigina & Ikonnikov 14797* (1b). *Lavrenko & Czen Lin-tzy 120* (6b). *Lavrenko & Rodin 887* (4a), *945* (4a). *Lavrenko, Stanjukovicz & S. S. Ikonnikov* 7.viii.1953 (1a). *Lazikov* 4.v.2005 (4c), 17.v.2005 (4c). *Licent 3940* (6b). *Linchevskii 281* (8). *Linzevki & Maslennikova 1239* (1a). *Lipschitz 92* (5), *1054* (1a). *Lipsky 4407* (1a), *4530* (4b), 11(23).vii.1896 (1a), 16(28).vii.1896 (1a), 8/20.viii.1896 (1a), 27.v.1897 (4b), 29.v.1897 (4b). *Litwinow 2174* (1a). *Lomonosova & Vershinin 2846* (1b). *Medvedeva* 21.v.1954 (1c). *Medvedeva, Markova, Neustrueva, Knorring, Denisova & Semenova 133* (1a). *Merton 3950* (1c). *Michelson 51* (1b), *234* (4a), *319* (1a), *1341* (1a), *1356 x* (1a), *1467* (1a), *1635* (1a), *1635 x* (1a), *1983* (4b), *2034* (1a), *2229* (1a), 16.v.1911 (1c), 19.vi.1913 (1a), 13.v.1914 (1a), 13.v.1914 (1a), 13.vi.1914 (1a), 26.viii.1935 (1a). *Miehe 5583* (1a). *G. Miehe & S. Miehe 5429* (1b). *Mikeschin 93* (4b). *Minkwitz 142* (1a), *310* (5). *Mülhlenweg 5637* (1b). *Muravljansky 82* (3). *Musajev & Sadychov* 23.vi.1973 (14). *Nekaeva 385* (3), 11.vi.1948 (3). *Nepli* 18.v.1960 (4b). *Nepli & Varsevtseva 536* (1b). *Neustrueva, Knorring & Tsvetkova 208* (5). *S. A. Nikitin 1366* (1a). *S. A. Nikitin & Kulik 228* (1a). *S. A. Nikitin & Mikhailova* 8.vi.1932 (3). *V. A. Nikitin 31* (1a), *232* (1a). *V. A. Nikitin &*

Sidoranko 256 (1a). *Ogurejeva* 15.vii.1968 (1b). *Ovczinnikov 144* (4c). *Ovczinnikov & Afanasiev 1024* (9), *832* (9). *Ovczinnikov & Slobodov*, 3.vi.1932 (4c), 7.vi.1932 (14a), 7.vii.1932 (1a). *Pabot 75AB* (1c), *1110* (4a), *181* (1a), *1309* (1a), *4293* (1c), *4299* (1a), *4345* (1a), *4511* (1a), *4543* (1a), *4887* (1a), *7813* (1c), 15.x.1958 (1a). *Paulsen 404* (1a), *407* (4c), *683* (1b). *Pavlov 62* (1a), *82* (1a), *125* (1b), *128* (1b), *165* (7), *167* (7), *443* (5), *875* (1a). *Persson 107* (1a). *Peshkova 1111* (1b), 9.vii.1953 (1a). *Petrov* 4.vii.1943 (6b), 21.v.1957 (6b), 12.v.1958 (6b), 4.vi.1958 (6b), 10.vi.1958 (6b), 11.vi.1958 (6b), 13.vi.1958 (6b), 18.vi.1958 (6b), 2.viii.1958 (6a). *Petrova 118* (1a), *204* (1a). *Petshikov* 20.vii.1972 (7), 2.iv.1936 (7). *Piataeva 336* (7), 12.vi.1936 (5). *Podlech 12051* (4a), *19063* (1a), *31631* (4a), 28.vii.1965 (4a). *Popov* 4.vii.1929 (6a). *Potaeva81* (1a). *Potanin* 14.viii.1886 (6b), 20.viii.1886 (6b). *Priajin* 26.v.1964 (4b). *Prianishkov 126* (8). *Ptaschicki 268* (1a). *Puchkova 152* (9). *Raikova 306* (1b), 18.vii.1945 (1b), 18.viii.1948 (1b). *Rechinger 1357* (4a), *18898* (4a), *19128* (1a), *19182* (1a), *52843* (1c), *57303* (1a, 1c). *Regel 493* (5). *Rioux & Golvan 75* (1a). *Rodenburg 233* (4a). *Rodin, Rachkovskai, Sokolov, Sujoverko, Novichkova & Sdobnikova 2188* (1c), *3011* (1c). *Ronginskaia & Azemsha* 10.vii.1953 (1b). *Rubov* 18.vii.1937 (1a). *Russacoow* 2.vi.1926 (1a). *Saposchnikov* 9.vi.1913 (9), 14.vi.1913 (1a). *Saposchnikov & Genina* 1.vii.1914 (1a). *Saposchnikov & Schischkin* 1.v.1912; (1a), 5.v.1912 (1a), 13.vii.1912 (1a). *Schischkin BK & Genina* 8.vi.1913 (1a). *Schischkin V.* 11.vii.1934 (1a). *Schmid 6371* (1a). *Seidmuradova* 9.vi.1911 (4a). *Sidorenko 81* (1a). *Sidorov 79* (1b), *50* (1b), *68* (1b), *172* (1b), *8101* (1b). *Sintenis 882* (1a). *Smirnow 46* (1a), *48* (11). *Sobolevskaia* 7.viii.1946 (1b), 27.vii.1947 (1b). *Sobolevskaia & Sokolobym 162* (1a). *Sovritkina 549* (1b). *Sovetkina & Uspenskaia 339* (10), *805* (1a). *Stanjukovich 132* (1b), 23.vii.1945 (1b), 27.v.1948 (1b), 1.viii.1948 (1b). *Stanjukovich & Kishkovskii 311* (1b), *219* (1b). *Stanjukovich, Sidorov, Krivonogova & Ladigina* 2176 (1b). *Stanjukovich, Sidorov, Krivonogova, Ladigina & S. S. Ikonnikov S. 3011* (1b). *Stapf* ix.1885 (1a). *Steshenko* 1.viii./6.ix.1951 (1b), 1961 (1b). *Stewart 442a* (1b). *Takhtajan, Mulkidzhaninan & Gabrielian 131078* (14). *Tsatsenkin* 30.vi.1941 (7). *Tekutiev 171* (5). *Timojina & Djukov 1714* (1b). *Timojina & Mrijin 3193* (7). *Timojina & Sakovich 1678* (1b). *Titov 1648* (1a), *254* (1a). *Tolmatceva 4759* (1a). *Tranzschel* 7.vi.1900 (4c). *Trulevich* 1.vii.1966 (1a). *Trulevich & Kojevnikova* 30.viii.1964 (1a). *Tsatsekin* 27 vi.1941 (6b). *Tsinzerlin & Zvianieva* 11.vii.1916 (1b). *Tugarikov* 18.viii.1926 (6b), 7.v.1941 (6b). *Tulinow* 1901 (1b). *Tuturin & Bessedin 379* (4a), *371* (4a). *Tzvelev 5* (8), *7* (4c), *25* (1b), *38* (8), *39* (1a), *850* (1b), *860a* (1a), *910* (1b), *1696* (1b).*Unger 117* (4a). *Vasák* 24.v.1973 (1a), 12.vii.1973 (1a), 28.vii.1973 (1a), 29.v.1974 (1a). *Volk 1281* (4a), *1726* (1a), *71/212* (1a). *Wendelbo & Foroughi 12878* (1c). *Woronow 14* (1a). *Wündisch 1381* (1b), *1441* (1a). *Xu Lang Ren et al*. 18.vi.1886 (1b). *Yuzepchik 437* (1a). *Zabriagaev 279* (1a). *Zapriagaeva 712* (1a). *Zapriagaeva & Konnov 1088* (1a). *Zapriagaeva, Zabolotskaia & Ilianskaia 864* (1a). *Zapromunova* 15.viii.1934 (1a).

Capítulo 4. Revisión taxonómica de las euroasiáticas *Stipa* subsecciones *Stipa* y *Tirsae*. (Poaceae). Taxonomic revision of the Eurasian *Stipa* subsections *Stipa* and *Tirsae* (Poaceae)

Resumen

En el presente trabajo se ha realizado una revisión taxonómica de *Stipa* subsecciones *Stipa* y *Tirsae*. Los patrones de variación morfológica de cada uno de los taxones de ambas subsecciones fueron analizados a través del estudio detallado de 1353 pliegos procedente de 27 herbarios. La variabilidad morfológica de la flor y de las hojas fue explorado en 165 especímenes para reevaluar los limites de los diferentes taxones, para ello se emplearon análisis univariantes (Anova Tukey test, Chi cuadrado), y análisis multivariantes (análisis de componentes principales y análisis discriminantes). Los análisis fueron capaces de distinguir una especie para la subsect. *Tirsae* y 3 especies y tres subespecies para la subsect. *Stipa*. Se proporciona un clave para especies y subespecies, y cada taxon va provisto de sinónimos, una descripción morfológica detallada, ilustraciones y un mapa de distribución. Además, los siguientes neotipos son propuestos para *S. pulcherrima* var. *mollis* (subsect. *Stipa*) y *S. aperta* (subsect. *Stipa*) y un lectotipo para *S. cerariorum* (subsect. *Tirsae*). Igualmente, se propone dos combinaciones nuevas: *Stipa* subsect. *Tirsae* (Martinovský) R. Gonzalo, y *Stipa turkestanica* subespecie *macroglossa* (P.A. Smirn.) R. Gonzalo.

Taxonomic revision of the Eurasian *Stipa* subsections *Stipa* and *Tirsae* (Poaceae)

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Abstract—A comprehensive taxonomic revision of *Stipa* subsects. *Stipa* and *Tirsae* is presented. We analyzed the pattern of morphological variation of the taxa included in both subsections through the study of 1353 vouchers from 27 herbaria. Variation in floral and leaf morphology was further explored to revaluate taxon limits in 165 specimens using univariate analyses (Anova, Tukey test and, Chi-square test), and multivariate tests (principal components analysis, and discriminant analysis). We found that one species of subsect. *Tirsae*, and three species plus five subspecies of subsect. *Stipa* can be distinguished based on morphological characters. For each taxon, we present a dichotomous keys, a list of synonyms, detailed morphometric descriptions, illustrations, and distribution maps. In addition, neotypes are proposed for *S. pulcherrima* var. *mollis* (subsection *Stipa*) and *S. aperta* (subsection *Stipa*), and a lectotype is proposed for *S. cerariorum* (subsection *Tirsae*). Likewise, two new combinations are proposed: *Stipa* subsection *Tirsae* (Martinovský) R. Gonzalo, and *Stipa turkestanica* subspecies *macroglossa* (P.A. Smirn.) R. Gonzalo.

Keywords—Asia, Europe, multivariate analyses, *Stipa pennata*, *Stipa tirsa*, taxonomy.

The Poaceae is among the largest plant families of angiosperms, including around 800 genera and 11000-13000 species (Soreng et al. 2007) in 12 subfamilies and 42 tribes (GPWG 2001). Placed within subfamily Pooideae (GPWG 2001), tribe *Stipeae* is a well-defined monophyletic group (Peñailillo 1996; Hsiao et al. 1999; Jacobs et al. 2000, 2007) with approximately 21 genera (Romaschenko et al. 2010) and 400-600 species, distributed in all continents excluding Antarctica (Barkworth et al. 2008; Romaschenko et al. 2007, 2010; Cialdella et al. 2010). The tribe is characterized by a single-flowered spikelet, glumes equalling or longer than the lemma, an apical awn, and two or three lodicules (Clayton and Renvoize 1986). In addition, small chromosomes with a base number of x =10-12 are also diagnostic (Tzvelev 1976; Freitag 1985; Romaschenko et al. 2007, 2010).

Besides the limits of tribe *Stipeae* are more or less recognized, generic circumscriptions have been controversial and have changed dramatically in the last decades. The major area of uncertainty has been in defining the circumscription of the genus *Stipa* (Jacobs *et al*., 2007). Traditionally, the limits of *Stipa* have been drawn broadly (Spegazzini 1901, 1925; Hitchcock 1925, 1951), encompassing most of the currently accepted genera in the tribe, except for *Oryzopsis* Michx., *Piptochaetium* J. Presl, *Nassella* E. Desv. and *Aciachne* Benth. This traditional concept of the genus includes ca. 300-400 species of temperate and subtropical regions in both hemispheres

(Clayton and Renvoize 1986; Tzvelev 1976; Bor 1970; Cope 1982; Moraldo 1986; Freitag 1985; Watson and Dallwitz 1992). However, recent morphological, anatomical and molecular studies have substantially changed the generic boundaries in the tribe. As result, *Nassella* has been significantly expanded, becoming the second largest genus in the tribu with around 116 species (Barkworth et al. 2008). Older genera have been resurrected (*Jarava* Ruiz and Pav., *Macrochloa* Kunth), and new ones have been described: *Hesperostipa* (M.K. Elias) Barkworth, *Austrostipa* S.W.L. Jacobs & J. Everett, *Celtica* F.M. Vázquez & Barkworth, *Amelichloa* Arriaga & Barkworth and *Pappostipa* (Speg.) Romasch., P.M. Peterson & Soreng. The current circumscription of *Stipa* includes approximately 140 species (Barkworth et al. 2008) geographically confined to Asia, Europe and North Africa (Romaschenko et al. 2007; Barkworth et al. 2008).

In the current circumscription of Stipa, the genus is characterized by spikelets 1-flowered, and the anthecium disarticulates above the glumes leaving a sharp-pointed callus attached at its base. The lemma is often very long and narrow, terete, indurate, and strongly convolute, terminating in a prominent awn. The callus, lemma and the palea considered together is called the anthecium. The awn is unigeniculate or bigeniculate and usually twisted below the first bend. The portion below the bend is referred to as the column and above the bend is referred to as the seta.

The genus *Stipa* includes some of the taxonomically most difficult species in *Poaceae*, exhibiting great plasticity in morphological characters. The lack of stable morphological structures and the difficulty in establishing clear morphological boundaries between taxa, has resulted in complicated infrageneric classifications, with the creation of a high number of taxa at the specific and infraspecific ranks (Smirnow 1925, 1926, 1928, 1929, 1938, 1970; Martinovský 1982; Klokov and Osȳchnyuk 1976; Moraldo 1986; Vázquez and Gutiérrez 2011). These problems were previously pointed out by Tzvelev (1974, 1976), Scholz (1985), Freitag (1985), and Strid (1991).

The infrageneric classification of *Stipa* has suffered many changes along its taxonomic history. Dumortier (1823) was the first author to provide an infrageneric classification, with two sections based on the awn features: (1) sect. *Eriostipa* Dumort., with "*Arista plumosa vel pubescent,*" including *S. pennata* L.; and, (2) sect. *Leiostipa* Dumort., with "*Arista glabra,*" including *S. capillata* L. Most European and Asian species were subsequently included in sect. *Eustipa* Trin. & Rupr. (Endlicher 1836; Steudel 1854). The first comprehensive infrageneric classification of *Stipa* species from the former Soviet Union was published by Roshevitz (1934), who recognized seven series based basically on the awn morphology: (1) ser. *Pennatae* Roshev.: including all species with a glabrous or scabrous column and a plumose seta, including *S. pennata*, the type species of the genus; (2) ser. *Sibiricae* Roshev.: with pointed glumes, lemma shorter than glumes and awn less than 2 cm; (3) ser. *Brevigeniculatae* Roshev: with awn unigeniculate and the column 1/10-1/8 as long as the seta; (4) ser. *Barbatae* Roshev.: with the awn hairy all along its length; (5) ser. *Tortiles* Roshev.: with the column hairy and the seta glabrous or scabrous; (6) ser. *Pseudocapillatae* Roshev.: column with hairs up to 7 mm long and seta scabrous or shortly hairy; and (7) ser. *Capillatae* Roshev.:

awn scabrous at the edges. Roshevitz's classification has been the starting point for future taxonomic studies of the genus.

During the second half of the last century, several have been the contributions trying to clarify the infrageneric taxonomy of *Stipa* (Bor 1970; Tzvelev 1974, 1976; Martinovský 1977, 1982; Moraldo 1986; Vázquez and Gutiérrez 2011; see table 1). However, placements of the species as well as the limits of the sections are still unclear and changes in purpose the taxonomist interpretation. For example, sections *Aristella* (Trin.) Hackel and *Lasiagrostis* (Link) Hackel are currently encompassed under *Achnatherum* P. Beauv. (Tzvelev 1976), whereas the section *Orthoraphium* (Nees) Hackel and ser. *Gigantea* Martinovský are retained at generic rank (Tzvelev 2000; Wu and Phillips 2006; Vázquez and Barkworth 2004). *Stipa gaubae* Bor has been indistinctly placed under section *Barbatae* A. Junge (Freitag 1985), section *Smirnovia* Tzvelev (Vázquez and Gutiérrez 2011) or in its own section, *Subsmirnovia* Tzvelev (Tzvelev 1993; Gonzalo et al. 2011). Species with the awn totally pilose are included in sect. *Barbatae* (Klokov and Osȳchnyuk 1976; Tzvelev 1976) or in sect. *Stipa* of ser. *Barbatae* (Bor 1970; Moraldo 1985).

The current concept of the type section, includes approximately 60 species from North Africa, Europe and Asia, characterized by: caespitose habit, long acuminate glumes, terete lemma with longitudinal rows of hairs, bigeniculate awn, glabrous or minutely scabrous (rarely hairy) column, plumose seta with hairs longer than (3)4 mm long and ovary with 2 styles (Tzvelev 1976; Vázquez and Devesa 1996).

Landmarks in the taxonomical knowledge of *Stipa* sect. *Stipa* are Martinovský's (1966, 1967, 1970, 1976, 1977, 1980, and 1982) revisions, mostly focused on the European species. He described several new taxa and divided the section into five series and five subseries (Table 1), a concept followed and extended by other European taxonomist (Klokov and Osȳchnyuk 1976; Moraldo 1986; Vázquez and Gutiérrez 2011). Series *Lessingianae* Martinovský includes the widespread *S. lessingiana* Trin. & Rupr., characterized by having the lemma completely pubescent and the ligules of the basal leaves very short. This taxon is currently separated in the monotypic sect. *Subbarbatae* Tzvelev. Series *Pulcherrimae* Martinovský is characterized by having the dorsal row of the lemma absent or shorter than the subdorsal row (rarely slightly shorter), and the ventral row of hairs reaching the top (rarely ending 1-2 mm below the apex). Martinovský (1966, 1967, 1977), divided series *Pulcherrimae* into 4 subseries: subseries *Syresitschikovianae* Martinovský includes the species with hairy column, whereas the other three subseries are distinguished by the ornamentation of the adaxial surface of the basal leaf-blade: subseries *Atlanticae* (pubescent), subseries *Epilosae* (scabrous, tuberculate or papillose), and suberies *Eriocaulis* (scabrous ribs and shortly pubescent furrows). Series *Dasyphyllae* Martinovský only differs from series *Pulcherrima* in the pubescent abaxial surface of the basal leaf-blade.

TABLE 1. Infrageneric classification of *Stipa s.s.* In bold the infrageneric groups currently included in Sect. *Stipa s.s.*

ROSHEVITZ (1934), Former USSR only	BOR (1970), Iran only	TZVELEV (1974, 1976, 1993), former URSS and Caucasus only	MARTINOVSKÝ (1965, 1966, 1967, 1970, 1975, 1976), Europe only	FREITAG (1985), S and SW Asia only	KLOKOV AND OSŸCHNYUK (1976), Ukraine	MORALDO (1985), Italy only	VÁZQUEZ AND GUTIÉRREZ (2011), seta plumose species only
Ser. *Pennnatae*	**Sect. *Stipa***	**Sect. *Stipa***	**Sect. *Stipa***	**Sect. *Stipa***	**Sect. *Stipa***	**Sect. *Stipa***	**Sect. *Stipa***
Ser. *Sibiricae*	Ser. *Inaequiglumis*	Sect. *Subbarbatae*	**Ser. *Pulcherrimae***	Sect. *Aristella*	**Ser. *Dasyphyllae***	**Ser. *Pulcherrima***	**Ser. *Stipa***
Ser. *Brevigeniculatae*	Ser. *Sibiricae*	Sect. *Achnatheropsis*	**Subser. *Eriocaulis***	Sect. *Orthoraphium*	**Ser. *Atlanticae***	**Subser. *Eriocaulis***	**Ser. *Atlanticae***
Ser. *Barbatae*	Ser. *Brevigeniculatae*	Sect. *Barbatae*	**Subser. *Atlanticae***	Sect. *Ptilagrostis*	**Ser. *Eriocaulis***	**Subser. *Atlanticae***	**Ser. *Dasyphyllae***
Ser. *Tortiles*	Ser. *Barbatae*	Sect. *Leiostipa*	**Subser. *Epilosae***	Sect. *Achnatheropsis*	**Ser. *Pulcherrimae***	**Subser. *Epilosae***	**Ser. *Syreistchikovianae***
Ser *Capillatae*	**Ser. *Pennnatae***	Sect. *Pseudoptilagrostis*	**Subser. *Syresitschikovianae***	Sect. *Pseudoptilagrostis*	**Ser. *Poëticae***	**Ser. *Siculae***	**Ser. *Tirsae***
Ser. *Pseudocapillatae*	Ser. *Tortiles*	Sect. *Regelia*	**Ser. *Tirsae***	Sect. *Stipella*	**Ser. *Rubentes***	Ser. *Barbatae*	Sect. *Smirnovia*
	Ser *Capillatae*	Sect. *Smirnovia*	**Ser. *Dasyphyllae***	Sect. L*asiagrostis*	**Ser. *Penniciliferae***	**Ser. *Tirsae***	Sect. *Barbatae*
	Ser. *Pseudocapillatae*	Sect. *Stipella*	**Ser. *Penicilliferae***	Sect. *Barbatae*	**Ser. *Stenophyllae***	**Subser. *Syresitschikovianae***	Ser. *Barbatae*
	Sect. *Lasiagrostis*		**Subser. *Penicilliferae***		**Sect. *Parastipa***	Sect. *Leiostipa*	Ser. *Lessingianae*
	Sect. *Ptilagrostis*		Ser. *Lessingianae*		**Ser. *Paradoxae***	Ser. *Capillatae*	
			Sect. Leiostipa		**Ser. *Anomalae***	Ser. *Bromoides*	
			Ser. Barbatae		Sect. *Leiostipa*	Ser. *Capenses*	
			Ser Capillatae		Sect. *Barbatae*		
			Ser. Bromoides		Ser. *Lessingianae*		
			Ser. Gigantae				

Series *Penicelliferae* (subsect. *Stipa*) and series *Tirsae* (subsect. *Tirsae*), reviewed in this paper, include plants native to the temperate zones of Europe, Asia and Caucasus characterized by having the ventral row of hairs ending 2-5 mm below the lemma apex and with the dorsal row quite longer than the subdorsal ones. Martinosvský (1976) recognized three species for series *Penicelliferae*: *S. joannis* Célak., *S. borysthenica* Klokov ex Prokud. and *S. styriaca* Martinovský, with *S. joannis* as the type species. Currently, *S. joannis* is considered a synonym of *S. pennata* (Tzvelev 1976; Connert 1982; Vázquez and Devesa 1996), which is the type species of the genus (Hitchcock 1925) and consequently ser. *Penicelliferae* is considered synonymy of subsect. *Stipa*. The type subsection is also characterized by an apical tassel of hairs at the apex of the basal leaves although sometimes it is absent. As well as *S. pennata* subsp. *pennata* and subsp. *sabulosa*, two additional species from Asia (*S. kirghisorum* P.A. Smirn. and *S. turkestanica* Hack.) clearly fulfils within subsect. *Stipa*, whereas series *Tirsae* only includes *S. tirsa* Steven. This species is closely related to *S. pennata*, and morphologically very similar. However, *S. tirsa* clearly differs in few constant characters, as the ligule length, the basal leaf apex and in the ornamentation of the abaxial leaf surface. We consider these features of enough relevance to recognize subsect. *Tirsae*.

Despite sect. *Stipa* has been profusely studied (Smirnow 1925; Klokov and Osȳchnyuk 1975; Tzvelev 1976; Martinovský 1982; Moraldo 1985), these revisions only cover particular geographical areas of the section. As well, the weight of the characters used to separate these species is very light, compared to other species of the genus (*S. capillata*, *S. arabica* Trin. & Rupr., *S. capensis* Thunb.), resulting in highly confused and complicated classifications. The present study includes a taxonomic revision of members of subsect. *Stipa* and *Tirsae*, as part of a comprehensive treatment of *Stipa* sect. *Stipa*. Specifically, our study is aimed at (i) revaluating the species status, through examination of herbarium specimens from throughout the range of the group; (ii) conducting a broad analysis of the morphological traits to support the taxonomic circumscription; and (iii) supplying detailed maps and illustration of each taxon. Seven taxa are recognized: three species and three subspecies for subsect. *Stipa* and one species for sect. *Tirsae*.

MATERIAL AND METHODS

Morphological Sampling and Characters—The current revision is based on the study of 1353 herbarium specimens of subsections *Stipa* and *Tirsae* (Appendix 1) from the following herbaria: B, BR, C, COI, E, FI, G, GH, GOET, H, HBG, JE, K, L, LD, LE, M, MA, MEL, NY, PR, S, U, UPS, W, WAG, and WU. For the morphometric analyses, 165 specimens were used as operational taxonomic units (OTUs), selected to represent as far as possible, the entire geographical range and the morphological variability within each taxon. Specimens were distributed as follows: *S. pennata* subsp. *pennata* (37); *S. pennata* subsp. *sabulosa* (26); *S. kirghisorum* (27); *S. tirsa* (25); *S.*

turkestanica subsp. *turkestanica* (18); *S. turkestanica* subsp. *trichoides* (15); *S. turkestanica* subsp. *macroglossa* (17).

Initially, sixty-eight morphological characters were recorded, including those previously used in the taxonomy of *Stipa*, (Roshevitz 1934; Tzvelev 1976; Martinovský 1980; Freitag 1985; Vázquez and Devesa 1996; Gonzalo et al. 2011), as well as others used in the taxonomy of grasses. Species of these two sections have cleistogamous spikelets, consequently the size of the structures enclosed by the floret was determined by the size of the lemma. Characters with missing data and those that were either constant or too variable were excluded, reducing the number of characters analyzed to 33 (Appendix 2). Of these, 17 quantitative, 4 ratio derivate, and 12 qualitative, were scored as binary or multistate (Table 2).

Numerical and Statistical Analyses—Quantitative characters were analyzed by its mean value, range, standard deviation and significance using the SPSS 17.0 statistic package for Windows (SPSS Inc., Chicago, USA). Prior to the statistical analyses, every pair of characters in the dataset was subjected either to a Pearson´s or to a Krendall Tau correlation depending on their quantitative or qualitative status (Molina et al. 2008). Variables with high correlation (> 0.75) were eliminated to avoid redundant information. Quantitative data were also subjected to Shapiro-Wilk test for normality and to the Levene test of homogeneity. Not normal data and with heterogeneous variance were standardized and Log 10 transformed, to meet the assumption of normality required.

A principal component analysis (PCA) based on correlation matrix was used to evaluate the morphological variation between specimens (Pimentel et al. 2007). Only those axes corresponding to components with eigenvalues greater than 1.0 were extracted. Previous to the PCA, a Kaser-Meyer-Olkin (KMO) test and the Bartlett´s test of sphericity were performed to assess the suitability of the selected data for the analysis (Almeida-Pinheiro de Carvalho et al. 2004). The varimax rotation was used to maximize the variance of each factor.

The relationships between the different taxa were investigated using classification discriminant analyses (DA, cross validation). This method requires an *a priori* assignment of OTUs to groups allowing to determinate whether the recognized groups are statistically definable entities or whether there is too much variation within groups to allow classification (Sneath and Sokal 1973; Legendre and Legendre 1998; Saint-Laurent et al. 2000). For cross validation, 25% of the specimens studied were randomly excluded from the dataset and the discriminant functions were calculated for the remaining specimens. To represent the variability of the most discriminant characters within taxa, box-plots were prepared (Fig. 1). These plots contain medians and percentiles and were obtained using the STATISTICA package.

One-way analysis of variance ANOVA and the Tuckey's Post Hoc test were carried out for each quantitative character to assess the divergence among species, among subspecies within species, and to determine the importance of each quantitative character. Qualitative characters were studied through Chi-square analysis. Statistical analyses were performed with SPSS vers. 17.0 (SPSS Inc., Chicago, USA).

Morphological data were used to elaborate detailed morphological descriptions for each taxon. Additional data of habitat, distribution and chromosome number were based on the literature and information supplied on collection labels. Distribution data derived from herbarium specimens were used as basis to build detailed distribution maps, with the program ArcView GIS v. 3.2. (ESRI 1999).

Transversal sections of the basal leaves were obtained with a Bright Starlet 2212 Cryostatand, stained with Fasga mixture (Tolivia and Tolivia 1987) and photographed under optical microscopy. Ideograms of these were drawn by J. L. Castillo.

RESULTS

Morphology—HABIT. All species of *Stipa* subsects. *Stipa* and *Tirsae* are perennial and herbaceous grasses. Species are generally xerophilous, exhibiting intravaginal growth, with many vegetative shoots and few generative shoots, resulting into a "rossulate perennial" as defined by Freitag (1985).

VEGETATIVE BODY. The culms are erect, 2-4 noded and almost completely covered by the culm leaf-sheaths. In both subsections nodes are glabrous, whereas the ornamentation of the internode surface is highly variable even within the same species: normally glabrous in both subspecies of *S. pennata*, densely pubescent in *S. tirsa* and scabrous or pubescent in *S. turkestanica* and *S. kirghisorum*.

LEAVES. The ornamentation, shape, and size of ligules, leaf-sheaths, and leaf-blades are variable in the same plant, depending on whether it is the basal leaf or the culm leaf. There is also variation along the length of the leaves and its age.

LEAF-SHEATHS. Leaf-sheaths are glabrous, scabrous with prickles or with stiff hairs, papillose or pubescent. The leaf-sheaths of the basal leaves may be glabrous or ciliate, while the culm leaf-sheaths usually exhibit glabrous margins.

LEAF-BLADES. All the taxa are more or less xerophilous, having convolute or involute leaf-blades, being extremely thin in *S. tirsa* (up to 0.3 mm in diameter). The ornamentation of both sides of the leaf-blades has been traditionally used as a distinctive character for taxa delimitation (Martinovský 1982, Moraldo 1985; Klokov & Osȳchnyuk 1976). However, leaf-blades features have been considered less important than the spikelets morphology for the taxonomy of species with large distribution (i.e. *S. caucasica* Schmalh, *S. pennata*, *S. capillata* L.) due to its high variability, The exception is *S. tirsa*, in which leaf-blades ornamentation is stable, showing the abaxial surface covered by scattered stiff hairs, whereas the adaxial surface may be scabrous, papillose or rarely with scattered hairs. In all the species of subsect. *Stipa* abaxial surface is distinctly scabrous, with the exception of both subspecies of *S. pennata*, which may be either glabrous or minutely scabrous. The adaxial surface is extremely variable within the same taxon and may be scabrous, minutely pubescent, papillose, pubescent or with scattered hairs. The leaf-blades apex contains remarkable features, ending in a very delicate and long setaceous tip in *S. tirsa*, or in a fragile apical tassel of hairs on the young leaves of *S. pennata* and occasionally in *S. turkestanica*. However,

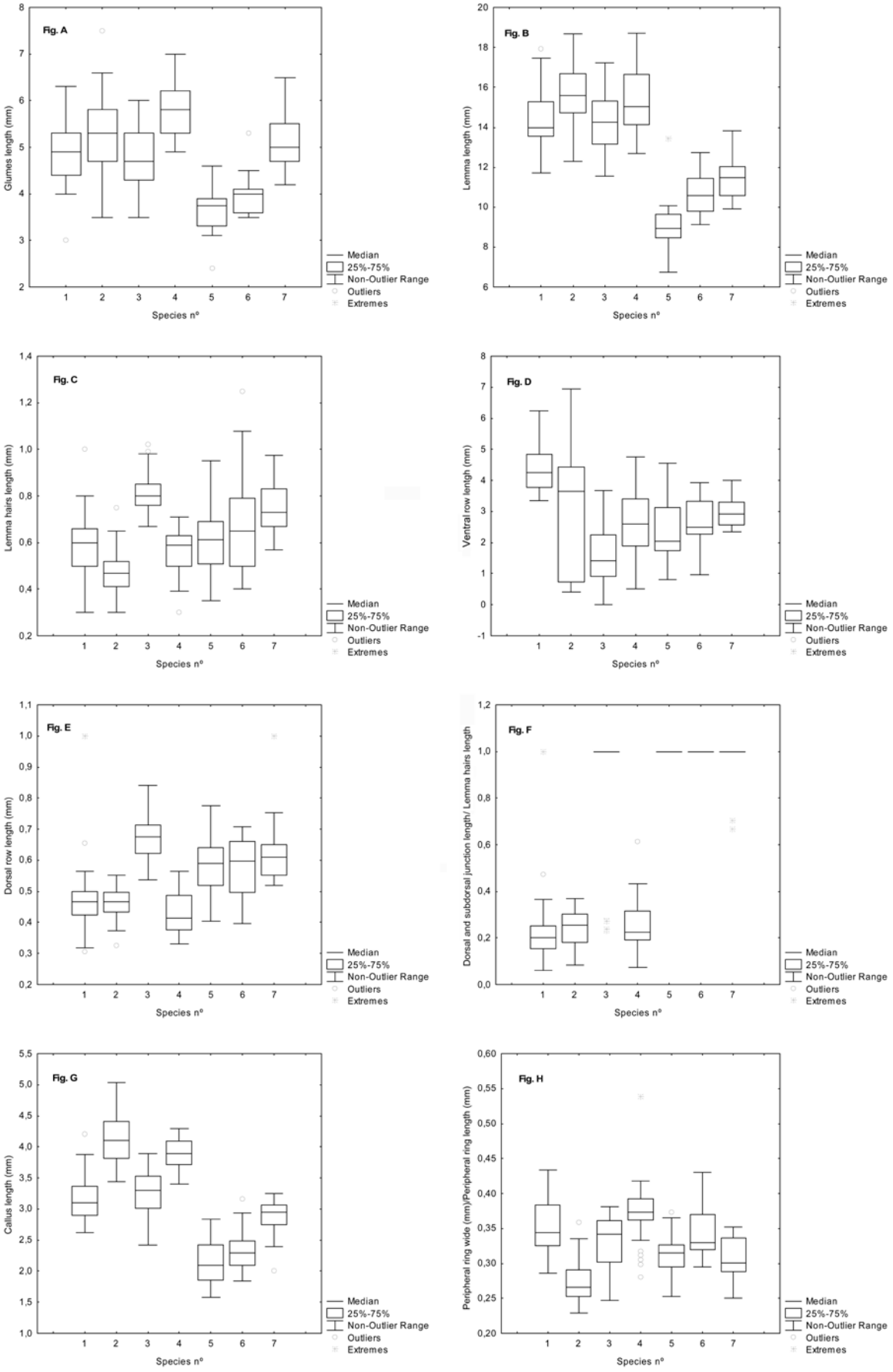
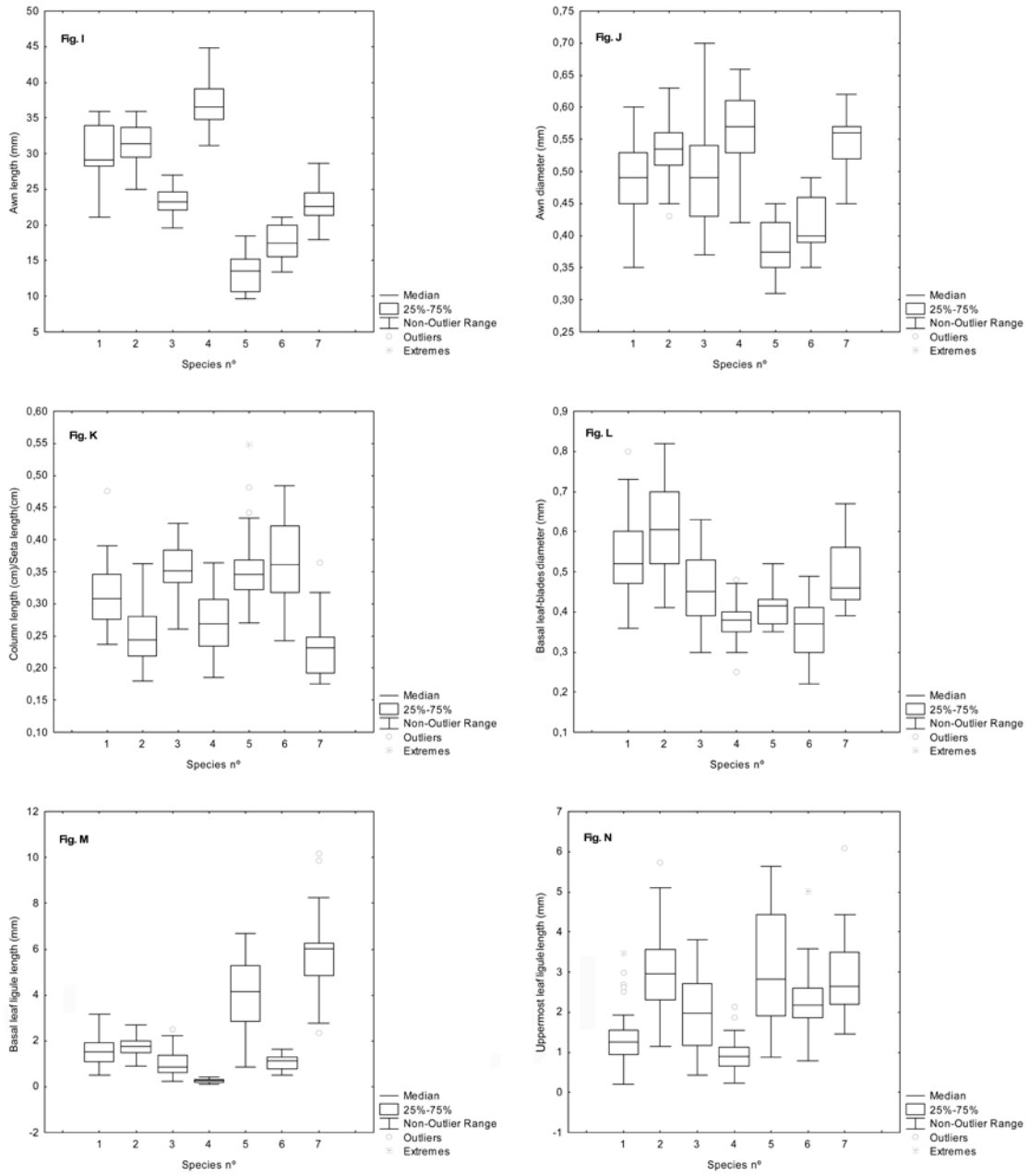


Fig. A
Glumes length (mm)
Species n°
Fig. B
Lemma length (mm)
Species n°
Fig. C
Lemma hairs length (mm)
Species n°
Fig. D
Ventral row length (mm)
Species n°
Fig. E
Dorsal row length (mm)
Species n°
Fig. F
Dorsal and subdorsal junction length/ Lemma hairs length
Species n°
Fig. G
Callus length (mm)
Species n°
Fig. H
Peripheral ring wide (mm)/Peripheral ring length (mm)
Species n°
Median
25%-75%
Non-Outlier Range
Outliers
Extremes



FIGS. 1 A-N. Box plots of the most discriminant variables. Numbers refer to the following taxa: 1. *S. pennata* subsp. *pennata*; 2. *S. pennata* subsp. *sabulosa*; 3. S. *kirghisorum*; 4. *S. tirsa*; 5. *S. turkestanica* subsp. *turkestanica*; 6. *S. turke*stanica subsp. *trichoides*; 7. *S. turkestanica* subsp. *macroglossa*.

this tassel is sometimes missing by its deciduous nature or because they are not developed. Histology of the leaf-blades of sect. *Stipa* has been profusely studied (Martinovský 1970, 1977, 1980; Connert 1982; Devesa 1992). Subsections *Stipa* and *Tirsae* are C3-grasses (XyMS+), with leaf-blades bearing adaxial ribs or "nodular" in transverse section (Watson & Dallwitz 1992) and mesophyll with non-radiate chlorenchyma. The abaxial surface of leaf-blades has a regular outline, whereas the adaxial one is divided into conspicuous ribs of unequal size, separated by deep and narrow furrows with V or U shapes (Figs. 7d, 9d, n). The number of ribs ranges from five to 11, in relation to the width of the leaf-blades. Apices of the ribs may be rounded

or quadrangular (Figs. 7d, 9n, d). Bulliform cells are displayed in discrete fan-shaped groups of three to five cells at the base of the furrows and they are usually small and inconspicuous.

Vascular bundles are more or less embedded in the middle of the mesophyll, and its number is correlated with the number of ribs. Two different kinds of vascular bundles are found, which typically alternate one with another (Figs. 7d, 14d). Each rib corresponds to one vascular bundle of the "basic type" (Metcalfe 1960), accompanied by sclerenchyma girders reaching both sides of the leaf-blades (Fig. 7d, 14d) or only the abaxial side when the ribs are less developed (Fig. 7d, 14d). Usually, each furrow displays, alternating with the ribs, a small bundle without girders or with these only joined to the abaxial surface. The xerophilous nature of the species of these two sections is reflected in the presence of continuous subepidermical layers of sclerenchyma connecting the abaxial girders to each another. Species from strongly xeric habitats exhibit much more developed girders and layers. Thus, populations of *S. pennata* and *S. tirsa* (Figs. 7d, 9n, d) from more mesophytic habitats have layers two cells tall, whereas *S. kirghisorum* (Fig. 14d) and *S. turkestanica* (Fig. 12c, m , r), from more xerophytic habitats show layers five to six cells tall. This layer is discontinuous and narrow at the adaxial surface, often interrupted at the furrows (Figs. 9n, d).

LIGULES. The shape and size are quite variable on the culm leaves but uniform on the basal leaves, bearing useful characters for species delimitation. *Stipa tirsa* has the basal ligules extremely short (up to 0.5 mm long) and truncate (Fig. 7e). On the other hand, *S. turkestanica* subsp. *turkestanica* and subsp. *macroglossa* show very long ((1.85)2.76-6.7(10.2) mm long) and lanceolate ligules (Figs. 12d, s).

INFLORESCENCES. Inflorescences are paniculate, contracted with few erect or almost erect branches and spikelets. The panicle is more or less enclosed by the upper leaf-sheaths in *S. tirsa*, whereas in species of subsect. *Stipa* the panicle is exserted or partially enclosed at the base, depending on the stage of development. An inconspicuous character is the ornamentation of the first internode of the panicle. The first internode is more or less pubescent in *S. tirsa* and *S. kirghisorum*, usually glabrous in *S. pennata*, whereas in *S. turkestanica* it is scabrous or more rarely pilose.

GLUMES. Glumes are subequal and always long acuminate. The number of nerves usually ranges from three to seven. The mid nerve usually extends up to the tip, while the lateral nerves occur in pairs and never reaching the tip. The glumes are glabrous with the midrib always ciliate in *S. tirsa* and indistinctly ciliate in species of subsect. *Stipa*. The tips of the glumes are very delicate and break easily; therefore much care should be taken when measuring these structures.

ANTHECIUM. In this work, we consider the anthecium including lemma, palea and callus. For convenience, the awn is not included in the length of the anthecium (Freitag 1985). The anthecium is coriaceous, with overlapping margins and enclosing both flower and caryopsis. All the structures that are enclosed in the anthecium (stamens, lodicules and ovary), despite having quite useful diagnostic characters, they are awkward to observe in herbarium specimens.

LEMMA. The lemma is glabrous or at most papillose near the apex and with seven rows of appressed to almost erect hairs. The ventral rows of hairs normally do not reach the apex. Occasionally, in a few specimens of *S. pennata*, *S. kirghisorum* and *S. tirsa* the ventral rows almost reach the top. *Stipa turkestanica* and *S. kirghisorum* have seven distinct rows of hairs, whereas in *S. tirsa* and *S. pennata* the dorsal and subdorsal rows are slightly fused at the base. In all the species, the dorsal row is always longer or at most equals the length of the subdorsal ones. The apex of the lemma is sometimes extended into short lobules surpassing the awn insertion. However, these lobules lack taxonomic value, because they may be present or not even within the same species. Generally, in floristic treatments of *Stipa*, what has been measured as lemma is actually the anthecium length.

CALLUS. The callus has a cylindrical shape and is usually hidden by the hairs, with a lowermost part acute, pungent, oblique, and curved, composed by the scar and surrounded by the peripheral ring (Freitag 1985). *Stipa pennata* subsp. *sabulosa* is the only taxa of the subsection showing a straight callus, with a very narrow peripheral ring (with a low width/length ratio). The callus is covered by straight and antrorse hairs, with the ventral hairs longer than the dorsal ones.

PALEA. The palea is enclosed by the lemma, and their lengths are relatively similar. A row of hairs between the two veins appears indistinctly in the different taxa.

LODICULE. The number of lodicules is three, one contiguous to the palea (ventral) and the other two (dorsal) flanking the dorsal side of the mature caryopsis. The dorsal lodicules are lanceolate, whereas the ventral one is lanceolate or linear-lanceolate and slightly longer or shorter than the dorsal one. Lodicules are usually glabrous but rarely have scattered hairs at the apex.

AWN. The awn is divided in two parts, column and seta (also called bristle). The column is the basal part of the awn and it is bent twice and twisted in subsect. *Stipa* and *Tirsae*. The seta is plumose, with hairs longer than 4 mm and flexuous, except in some specimens of *S. turkestanica*, in which the awns may be falcate. Scattered throughout the area of distribution of the species, some individuals show a distinct indumentum covering the column. Such forms were described as different subspecies or species. However, more convincing is the interpretation of Scholz (1985) upheld by Freitag (1985), who considered those specimens temporary aberrant forms or mutants.

STAMENS. There are three equal stamens per anthecium, whose size varies in proportion to the lemma length. The absence or presence of hairs at the apex occurs in different specimens of the same species, and in consequence stamens do not provide useful diagnostic characters.

OVARY AND CARYOPSIS. Ovaries are similar in all the species, glabrous, with 2 styles. The mature caryopsis is fusiform, with a linear hilum that almost reaches the top, and whose size varies in proportion to the lemma length.

Morphometric Analysis—Box plots showing the variability of the most discriminate characters are shown in Figs. 1A-N. The most operative ones were used to build the key to the species and subspecies (in conjunction with qualitative characters). Descriptive statistic and box plots show that species are clearly differentiated in few

characters, whereas the subspecies overlap for most of the characters studied. Floral characters such as lemma length, subdorsal and dorsal junction length (D_S)/lemma length, awn length and callus length are especially important for the differentiation of *S. turkestanica* and *S. kirghisorum* (Figs. 1B, F, G, I). Vegetative characters such as the basal leaf ligule length (Fig. 1M) are important for the differentiation of *S. tirsa*, *S. turkestanica* subsp. *turkestanica* and subsp. *macroglossa*, whereas the basal leaf diameter characterizes *S. tirsa* (Fig. 1L).

A high Pearson correlation was found in the distance between palea length, column length and seta length. Consequently, only twenty-seven characters were used for further analyses. One additional character (D_S/lemma length) was excluded in the DA 2, because it did not show variation within *S. turkestanica* and *S. kirghisorum.*

In the PCA performed for all the taxa, the KMO analysis rendered a value of 0.83, indicating the adequateness of our sample for multivariate analyses. The first three components accounted for 63% of the total variance observed. The first principal component (Axes 1) accounted for 39 % of the total variance and had high contributing

	PCA			DA 1			DA 2	
	Axes 1	Axes 2	Axes 3	Root 1	Root 2	Root 3	Root 1	Root 2
Glume length (cm)	**0.734**	0.002	0.141	-	-	-	-	-
Lemma length (mm)	**0.833**	-0.205	0.047	-	-	-	**0.620**	-0.066
Callus length (mm)	**0.882**	-0.198	-0.078	**-0.364**	**0.322**	**0.698**	-	-
Peripheral ring wide /peripheral ring length (PRW/PRL)	-0.052	0.038	**0.850**	0.017	**0.411**	**-0.306**	-	-
Awn lentgh (mm)	**0.827**	**-0.318**	0.297	**-0.523**	0.118	-0.105	**0.405**	**0.895**
Lemma hairs length (mm)	-0.027	**0.835**	0.077	**0.723**	0.192	-0.147	-	-
Awn diameter (mm)	**0.762**	0.187	0.045	**-0.315**	-0.226	0.101	-	-
Basal leaf-blade diameter (mm)	**0.362**	-0.073	**-0.333**	**0.300**	**-0.372**	0.233	0.262	**0.310**
Basal leaf ligule length (mm)	**-0.356**	**0.343**	**-0.393**	0.211	**-0.500**	-0.079	**-0.536**	**0.537**
Dorsal and subdorsal rows joining length D_S/lemma length	**-0.646**	**0.572**	-0.193	**0.427**	**0.406**	0.031	-	-
Ventral row length (mm)	0.065	-0.296	0.256	-0.214	**-0.362**	**-0.500**	-	-
Dorsal length/Lemma length	-0.184	0.071	-0.228	-	-	-	-	-
Columns length/seta length (COL/SET)	**0.725**	-0.253	**0.478**	-	-	-	0.21	**-0.559**
Plant height (cm)	**0.580**	-0.171	-0.250	-	-	-	-	-
Uppermost leaf ligule length (mm)	-0.221	0.186	**-0.699**	0.056	-0.280	**0.320**	-	-
Percent of total variance explained	39	14	10	52	29	19	67	31

TABLE 3. Factor loadings of the 13 characters for the first three principal components PCA and the standardized coefficient obtained in the DA 1 and 2. (-) Variables not used by the analysis. In bold, morphological characters showing the highest factor loadings and standardized coefficient.

loading values from glume length, lemma length, callus length, awn length and diameter, basal leaf-blade diameter, basal leaf ligule length, D_S/lemma length, column length/seta length (COL/SET), and plant height. The second component (Axes 2)

accounted for 14 % of the total variance and had high contributing loadings from awn length, lemma hairs length, basal leaf ligule length and, D_S/lemma length. Finally, the third component (Axes 3) accounted for 10 % of the total variance and had high contributing loadings from peripheral ring width /peripheral ring length (PRW/PRL), basal leaf-blade diameter, basal leaf ligule length, COL/SET and uppermost leaf ligule length.

In the scatterplot against the first two components, specimens are arranged in very loose and slightly overlapped groups (Fig. 2). Component 1 provides separation of *S. turkestanica* subsp. *turkestanica* and *trichoides*, mostly based on the smaller size of its floral characters. However, two OTUs of subsp. *turkestanica* and subsp. *trichoides* are intermingled with those of subsp. *macroglossa*. The remaining taxa, with larger spikeletes, are depicted on the centre or right side of the scatterplot. The specimens belonging to *S. tirsa*, *S. pennata* subsp. *pennata* and subsp. *sabulosa* are highly intermingled and occur on the lower right corner. The component 2 provides separation for specimens of *S. turkestanica* subsp. *macroglossa*, which are more or less confined to the centre upper quadrant. Specimens of *S. kirghisorum*, although rather dispersed, are placed in the upper quadrant, partially overlapping with *S. turkestanica* subsp. *macroglossa* and *S. pennata* subsp. *pennata*, holding an intermediate position between both taxa.

In the scatterplot against the first and third component (Fig. 3), samples of *S. turkestanica* subsp. *turkestanica* and subsp. *trichoides* are more clearly segregated at the left quadrant, whereas the remaining taxa form a single cluster.

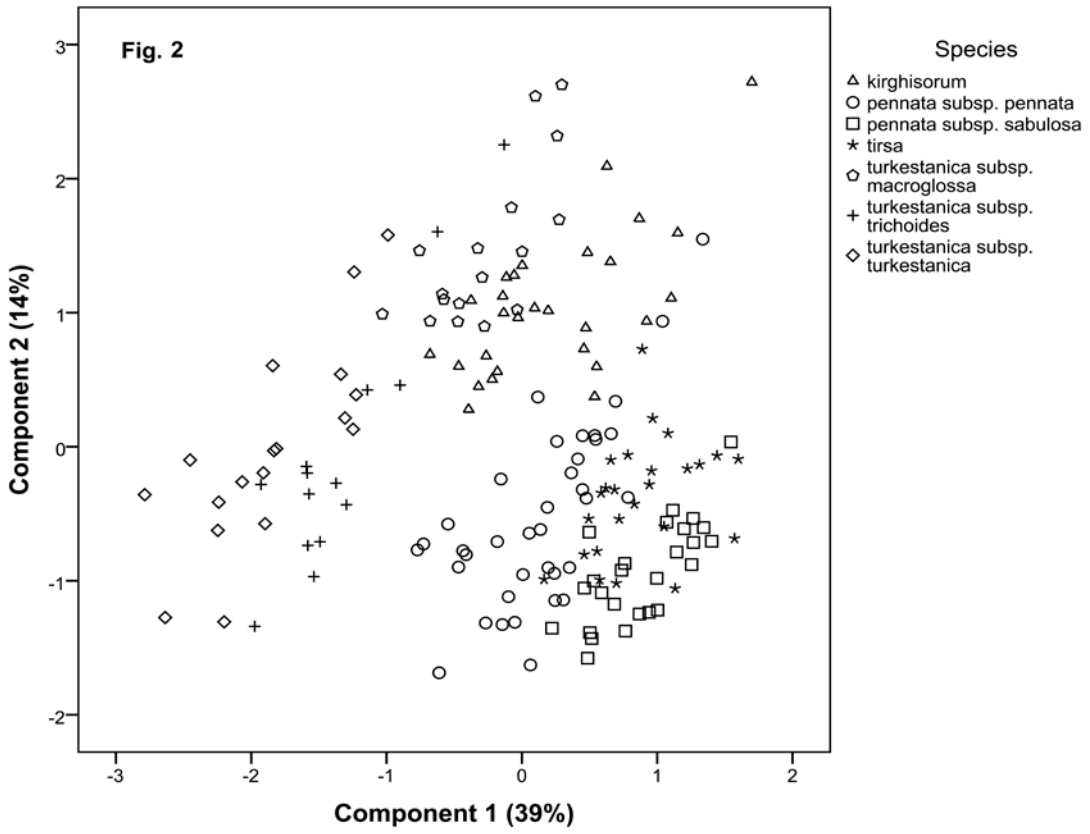


FIG. 2. Plot of the first two component of the principal component analyses (PCA).

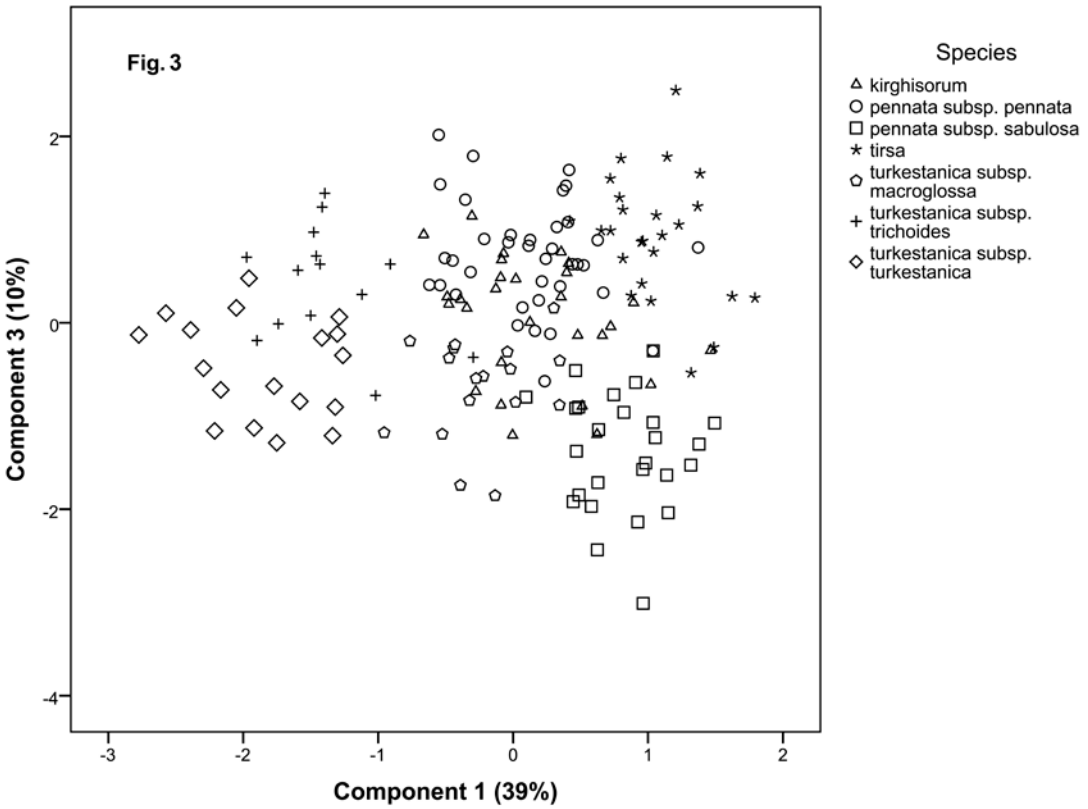


FIG. 3. Plot of first and third component of the principal component analyses (PCA).

In view of the results obtained from the PCA, two DA were carried out. The two subspecies of *S. pennata* and *S. tirsa* (group I) plus *S. kirghisorum* were analyzed in DA 1. The 2-D scatterplot of root 1 against root 2 (Fig. 4) reveals a more or less clear separation of the OTUs of *S. kirghisorum* from the remaining OTUs along the first component, whereas *S. tirsa* is completely separated along the second axes. Specimens of *S. pennata* subsp. *pennata* and subsp. *sabulosa* are continuously distributed in the scatterplot, with no differentiation observed. One specimen of *S. pennata* subsp. *pennata* is, as well, intermingled between specimens of *S. kirghisorum*. Characters such as lemma hairs length, D_S/lemma length, callus length, basal leaf-blade diameter, awn length and diameter were especially important for axes 1, whereas callus length, PRW/PRL, D_S/lemma length, basal leaf ligule length, basal leaf-blades diameter, and ventral row length were important in the second one (Table 3). However, as seen in Figure 5, that depicts the disposition of the OTUs in the space configured by the first and third root, subspecies *pennata* and *sabulosa* are partially separated along the third axes. The characters that more contributed for the third component were the callus length, ventral row length, uppermost leaf ligule length and PRW/PRL (Table 3). The cross-validation method well-classified 91.9%, 96.2% 96.3% and 100% of *S. pennata* subsp. *pennata*, subsp. *sabulosa*, *S. kirghisorum* and *S. tirsa* respectively. *Stipa pennata* subsp. *pennata* has one OTUs misclassified as subsp. *sabulosa* and two as *S. kirghisorum*, whereas S. *pennata* subsp. *sabulosa* and *S. kirghisorum* have one OTUs each, misclassified as *S. pennata* subsp. *pennata*. Willk,s Lambda values of the three

discriminant functions were 0.009-0.027-0.299, indicating the greater morphological differences of the taxa studied.

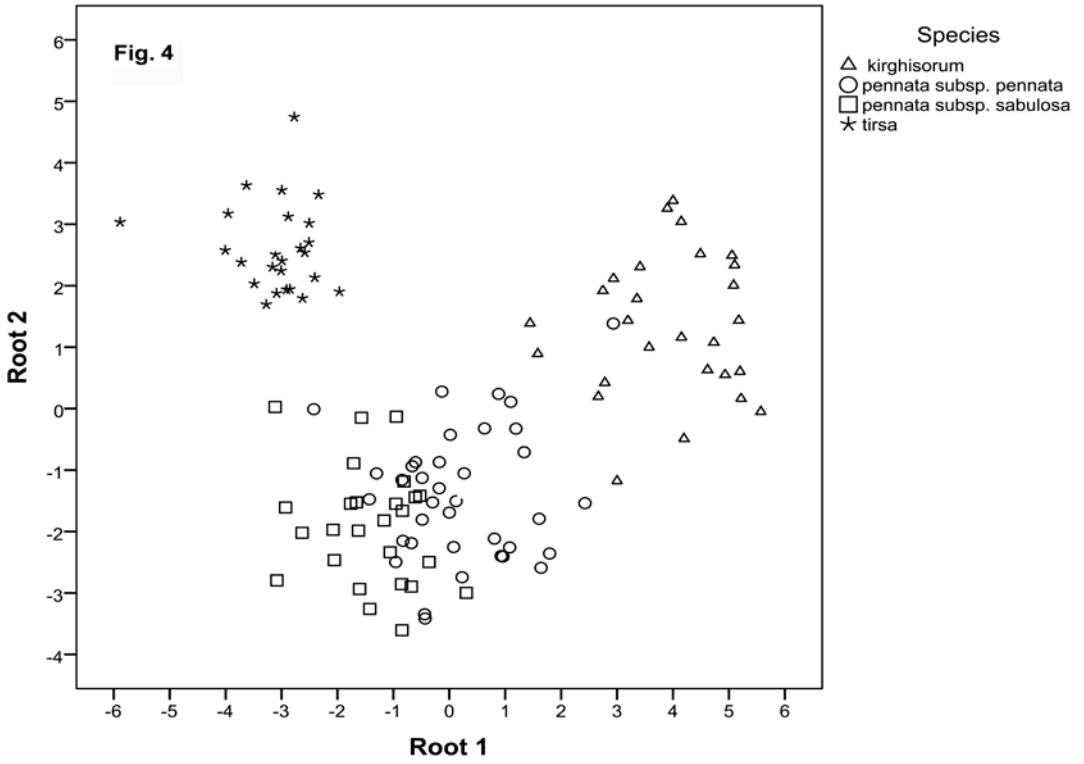


FIG. 4. Plot of the first two roots of the discriminant analysis for *S. pennata*, *S. kirghisorum* and *S. tirsa*.

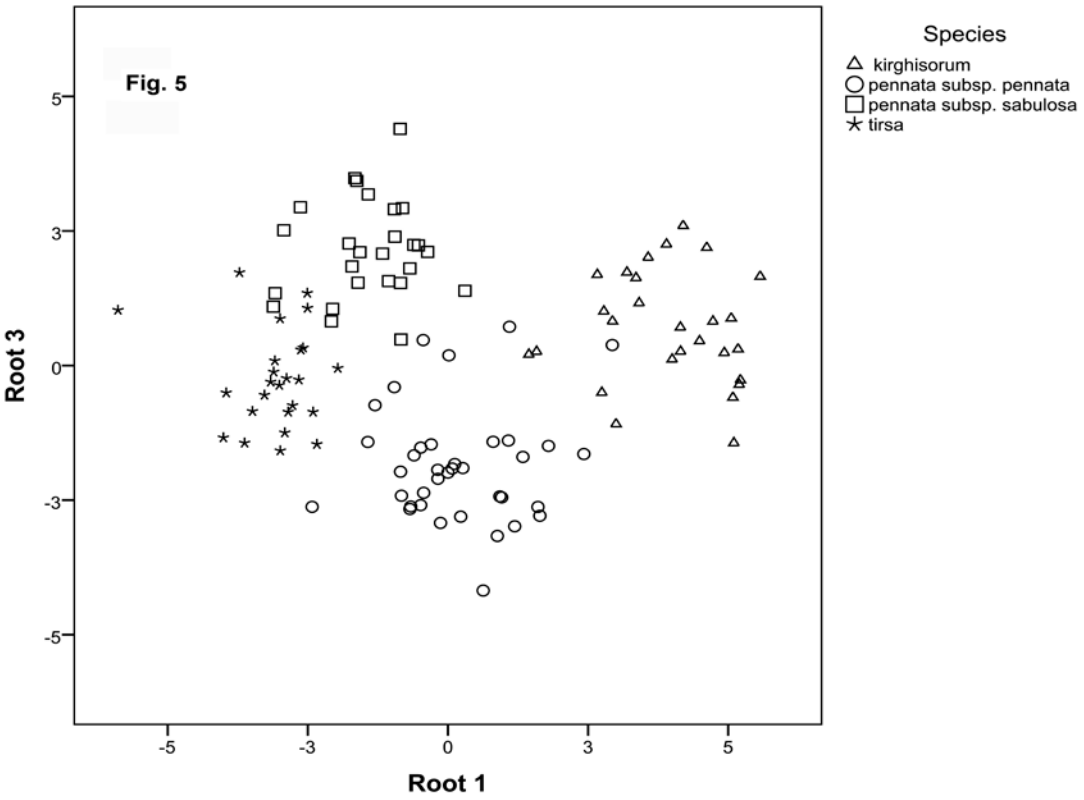


FIG. 5. Plot of the first and the third root of the discriminant analysis for *S. pennata*, *S. kirghisorum* and *S. tirsa*.

The three subspecies of *Stipa turkestanica* and *S. kirghisorum* were analyzed in DA 2 (Fig. 6). The 2-D scatterplot reveals an almost complete separation of all individuals of *S. kirghisorum* from the remaining samples along the first axis, whereas specimens of *S. turkestanica* subsp. *trichoides* and subsp. *turkestanica* slightly overlap their margins and with two specimens of subsp. *turkestanica* intermingled between those of subsp. *trichoides*. The highest loading for the first axis are the lemma length, awn length, and basal leaf ligule length. The second axis is responsible of the complete separation of *S. macroglossa*. However, one sample of *S. turkestanica* subsp. *macroglossa* clearly clustered with the other two subspecies of *S. turkestanica.* The highest loadings for the second axes are COL/SET, basal leaf ligule length, awn length and basal leaf-blades diameter. The percentages of well-classified OTUs were 100% for *S. kirghisorum* and *S. turkestanica* subsp. *trichoides*, but 88% for subspecies *macroglossa* and *turkestanica*. Subspecies *turkestanica* has two OTUs misclassified as subsp. *trichoides*, whereas subsp. *macroglossa* has one OTUs misclassified as subsp. *turkestanica* and another one as *S. kirghisorum*. Willk,s Lambda values for the first and second discriminant functions were 0.025-0.200, indicating the greater morphological differences of the taxa studied.

ANOVA (Tukey, post hoc test, $P < 0.01$) and Chi-square test detected significant differences in most of the characters studied when comparing individuals of the four species studied. The characters that best separate the species are the lemma length, lemma hairs length, callus length, awn length, basal leaf ligule length, D_S/lemma length, leaf-blades apex, and basal leaf abaxial ornamentation. However, subspecies are differentiated mainly by quantitative characters rather than qualitative. Among the three subspecies of *S. turkestanica*, none of the qualitative characters was significant, with the exception of the ligule margin (Table 2). They clearly differ in quantitative characters as the awn length, which is significantly different for the three subspecies; specimens of subsp. *macroglossa* have significantly longer glumes, callus, and basal leaf-blades diameter and shorter COL/SET, whereas subsp. *turkestanica* has significantly smaller lemma; specimens of subsp. *trichoides* are intermediate between the other two subspecies, and in addition it has shorter ligules on the basal leaf. Regarding the two subspecies of *S. pennata*, they are quite similar only differing in callus features (PRW/PRL and callus length), lemma length, and the ventral row length.

Finally, comparing *S. kirghisorum* to *S. pennata* subsp. *pennata* and to *S. turkestanica* subsp. *macroglossa*, two characters (COL/SET and ventral row length) show significant differences. Moreover, five traits (awn length, lemma hairs length, dorsal row length, ratio D_S /lemma length and panicle basal internode surface) statistically separate *S. kirghisorum* from *S. pennata* subsp. *pennata*, and three traits (lemma length, callus length, and ligule length) separate it from *S. turkestanica* subsp. *macroglossa*.

DISCUSSION

Multivariate techniques used in the present work did not yield the same level of resolution to separate groups of specimens according to their taxonomical arrangements.

In the PCA performed for the seven taxa analyzed, no clear pattern could be discerned, although some discrete groups appeared to be recognizable. Beyond that, the 2-D scatterplot does not provide a conclusive segregation for the different taxa studied. It should be noted that PCA is characterized by a faithful representation of distances between the major groups but is notorious for falsifying distances between close neighbors (Sneath and Sokal 1973). This is why ordination of smaller and related groups was checked with DA. Discriminant analysis is widely employed in systematics to discern among closely related taxa (Pimentel et al., 2010; Viruel et al., 2010). In summary, all analyses support the recognition of 4 species and 5 subspecies that have a set of very homogeneous morphological characters. Except for *S. tirsa*, there is not a unique character that by itself can be used to distinguish a particular taxon. Is the combination of several characters, in addition to its habitat and distribution what allows recognizing them.

Superficially, spikelets of *S. tirsa* resemble those of *S. pennata* and for that reason some authors have considered *S. tirsa* as a variety of *S. pennata* (Čelakovský 1884). Our analyses demonstrate that the distinctness of *S. tirsa* from the remaining taxa of subsect. *Stipa* is clear and supported by many qualitative and quantitative characters (Table 2; Fig. 2). These include its very short ligules, thin basal leaf-blades, longer size awn, setaceous apex of the basal leave, and the sparsely stiff hairs of the abaxial surface of the basal leaves.

By contrast, the recognition of *S. kirghisorum* is not so clear. This species shows ranges of morphological variation that overlap with those of *S. pennata* subsp. *pennata* and *S. turkestanica* subsp. *macroglossa*, requiring the combination of several characters to separate them. Some of the characters used by other authors for species identification performed well in our analyses. The most useful characters to separate *S. kirghisorum* and *S. turkestanica* subsp. *macroglossa* are the size of the basal ligule leaf (Pazij 1968; Bor 1970; Tzvelev 1976; Wu and Phillips 2006), which is (0.25)0.42-1.7(2.5) cm long in *S. kirghisorum* and (2.3)2.8-9.8(10.2) cm long in *S. turkestanica* subsp. *macroglossa* and the lemma size (Figs. 1C, M). Even though the size of the awn is similar, the ratio COL/SET is quite different, mainly due to the longer column of *S. kirghisorum*. More problems present the separation of *S. kirghisorum* and *S. pennata* subsp. *pennata*. *Stipa kirghisorum* has been considered a well-recognized species by all Asian taxonomists (Smirnow 1925; Pazij 1968; Tzvelev 1976, 2000), whereas Freitag (1985) in his revision of *Stipa* for South-West Asia treated *S. kirghisorum* as a subspecies of *S. pennata*. *Stipa kirghisorum* shares with subsp. *pennata* a general appearance, slightly overlapping in the DA 1 (Fig. 4). A set of the traditional characters used by previous authors (Smirnow 1925; Pazij 1968; Tzvelev 1976, 2000) such as the shorter awns, longer dorsal row, lemma with distinct rows of hairs, distinctly scabrous surface of the basal leaf-blades in addition to others found for the present study, as lemma hairs length dorsal row length and the panicle basal internode pubescent, allow its recognition. They also have different ecological preferences; *S. kirghisorum* is an alpine or subalpine taxon, whereas *S. pennata* is rarely found at high altitudes. Furthermore, the chromosome number of *S. kirghisorum* is $2n = 32$ (Tzvelev 1976; Freitag 1985),

whereas the chromosome number of *S. pennata* is 2*n* = 44 (Sheidai et al. 2006; Tzvelev 1976; Freitag1985). For all this reasons, we retain *S. kirghisorum* at specific rank. Nevertheless, the affinities of this taxon are not clear based only on morphology and further molecular investigations are required to help clarifying its systematic position and relationships.

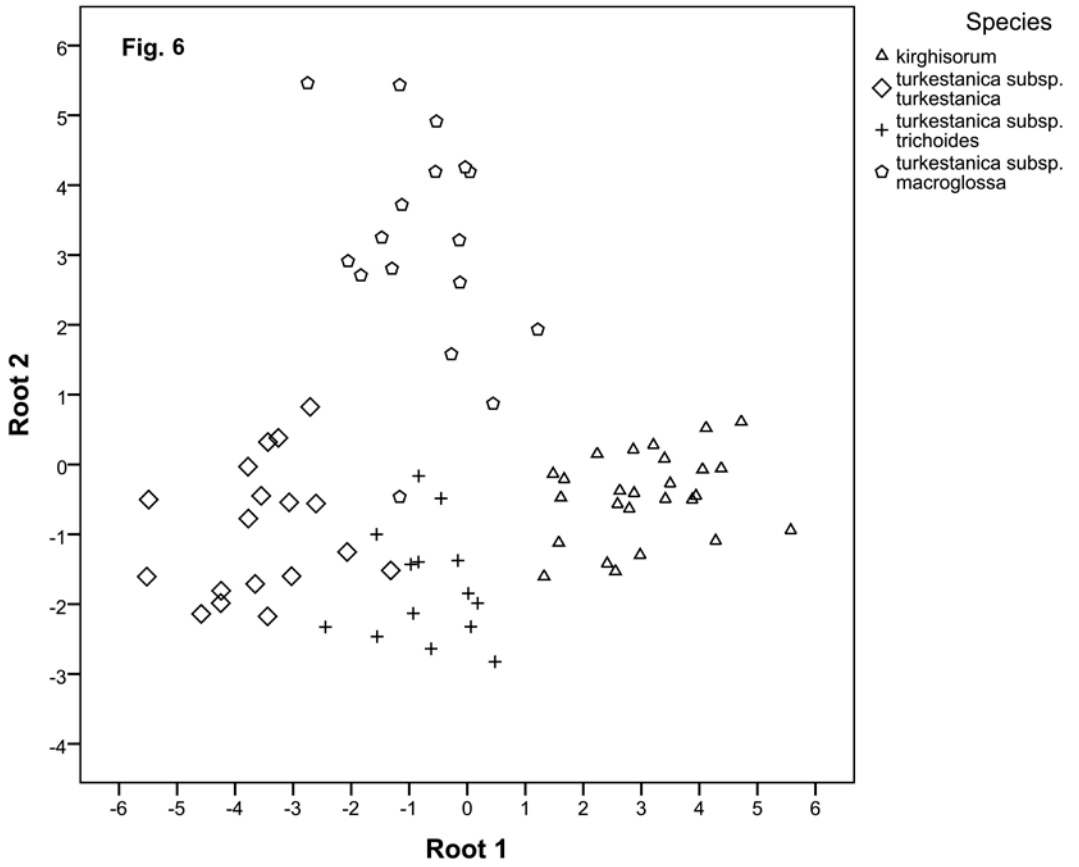


FIG. 6. Plot of the first two roots of the discriminant analysis for *S. turkestanica* and *S. kirghisorum.*

The different analyses performed showed that distinguishing the two subspecies of *S. pennata* is rather difficult. Subspecies *sabulosa* was originally described as a variety of *S. pennata*, and later recognized as subspecies by Lavrenko (1940) and Tzvelev (1976). Prokudin (1951) taking into account its habitat and its morphological features recognized it as a different species, rank accepted by Tzvelev (2006) in his revision for the Flora of Caucasus. Our analyses suggest that a reliable identification is only possible using quantitative characters of the floret. Other features previously used, as the scabridness of the surface of the upper leaf-sheaths, are highly variable. However, DA 1 (Fig. 5) shows that subsp. *sabulosa* has slightly longer lemmas and callus, the peripheral ring is somewhat straight and thin (low value PRW/ PRL), and the ventral row is closer to the lemma apex. In addition, both subspecies have different ecological preferences. Subspecies *sabulosa* inhabits sandy soils, whereas subsp. *pennata* is rarely found on sands. All these morphological and ecological differences suggest the recognition of two subspecies, as was proposed by Lavrenko (1940) and Tzvelev (1976).

TABLE 2. Main qualitative characters in *Stipa* subsects. *Stipa* and *Tirsae*.

	S. pennata subsp. *pennata*	*S. pennata* subsp. *sabulosa*	*S. kirghisorum*	*S. turkestanica* subsp. *turkestanica*	*S. turkestanica* subsp. *trichoides*	*S. turkestanica subsp. macroglossa*	*S. tirsa*
Leaf abaxial ornamentation	Glabrous or minutely scabrous	Glabrous or minutely scabrous	Distinctly scabrous	Distinctly scabrous	Distinctly scabrous	Distinctly scabrous	Sparcely stiff hairs
Leaf adaxial ornamentation	Scabrous, papillose or pubescent	Scabrous or papillose	Scabrous, papillose or pubescent	Pubescent, minutely pubescent or papillose	Pubescent, minutely pubescent or papillose	Pubescent, minutely pubescent or papillose	Usually papillose or scabrous
Leaf-blades apex	Usually with an apical tassel of hairs	With an apical tassel of hairs or glabrous	Glabrous	Usually glabrous	Usually glabrous	Usually glabrous	Delicate tip
Ligule margin	Ciliolate or glabrous	Ciliolate or glabrous	Ciliolate or ciliate	Usually glabrous	Usually ciliate	Usually glabrous	Ciliolate
Ligule tip	Ciliolate or glabrous	Ciliolate or glabrous	Ciliolate or ciliate	Ciliolate or glabrous	Usually ciliate	Usually ciliate	Ciliolate
Upper sheaths ornamentation	Glabrous, papillose or scabrous	Scabrous or papillose	Glabrous, papillose or scabrous	Usually papillose or glabrous	Usually papillose or glabrous	Usually scabrous or papillose	Scabrous, papillose and with stiff hairs
Culm ornamentation	Glabrous or scabrous	Glabrous or scabrous	Glabrous, scabrous or pubescent	Scabrous or pubescent	Scabrous or pubescent	Scabrous or pubescent	Pubescent
Panicles	Exserted or partially enclosed	Exserted or partially enclosed	Exserted or partially enclosed	Exserted or partially enclosed	Exserted or partially enclosed	Exserted or partially enclosed	Enclosed or partially enclosed
Panicle basal internode surface	Glabrous or scabrous	Glabrous or scabrous	Usually pubescent	Usually scabrous	Scabrous or pubescent	Usually scabrous	Pubescent
Dorsal and subdorsal row	Fused	Fused	Distinct	Distinct	Distinct	Distinct	Fused
Callus shape	Slightly curved	Straight	Slightly curved	Slightly curved	Slightly curved	Slightly curved	Slightly curved
Awns column surface	Glabrous (rarely pilose)	Glabrous	Usually glabrous	Glabrous or tuberculate	Glabrous or tuberculate	Glabrous (rarely pilose)	Glabrous

The separation of the three subspecies of *S. turkestanica* presents different problems. The specimens identified as subspecies *turkestanica* and *trichoides* are closely placed together in the DA 2, but only a few of them appeared intermingled within each other. Traditionally, both taxa have been either accepted as different species (Smirnow 1925; Ovczinnikov 1957; Pazij 1968) or *S. trichoides* as a subspecies of *S. turkestanica* (Tzvelev 1976). Delimitation of both taxa has been mostly based on features of the ligule of the basal leaf and the awn. Subspecies *turkestanica* displays longer ligules that are glabrous at the apex, and longer awns with a glabrous column. On the other side, subsp. *trichoides* shows shorter ligules with ciliate apex and shorter awns, frequently with a glabrous column. More recently, Freitag (1985) considered that those characters were not diagnostic and considered subsp. *trichoides* as a synonym of *S. turkestanica*. We have found that both subspecies are not easy to be distinguished from each other because of the similarity of their spikelets. However, specimens with short ligules and ciliate apex consistently display longer awns and lemma, whereas specimens with long ligules and glabrous apex have shorter awns and lemma. Thus, following Tzvelev (1976), we consider *S. trichoides* as a subspecies of *S. turkestanica*.

More evident are the diagnostic features of *S. turkestanica* subsp. *macroglossa*. This taxon has been considered a well-defined species closely related to *S. pennata*, from which can be distinguished by its longer ligules (Smirnow 1925). However, a detailed study of material available from all its distribution area, suggests a closer relationship with *S. turkestanica*. Subspecies *macroglossa* resembles a robust *S. turkestanica,* sharing the unusual long ligules of the basal blades-leaf (fig. 1M). It differs mainly in the much longer reproductive parts (Fig. 1), its ecological preferences and geographical distribution (Fig. 13). Subspecies *macroglossa* is restricted to lowlands and middle belts of mountains of the Tian Shan range, East and central Kazakhstan, whereas subsp. *turkestanica* is a more alpine taxon, with its northern limit located in the Alai Mountains of Kyrgyzstan. Both taxa share similar qualitative characters (Table 2), differing only in qualitative features of the spikelets (Fig.1). For this reason we propose to combine *S. macroglossa* as a subspecies of *S. turkestanica*.

TAXONOMIC TREATMENT

KEY TO SPECIES AND SUBSPECIES

1. Ligules of the basal leaves 0.1-0.4 mm long; abaxial surface of the basal leaf-blade with sparsely stiff hairs and with a long setaceous apex ..... **1. *S. tirsa***
1. Ligules of the basal leaves (0.3)0.7-5.6(10.2) mm long; abaxial surface of the basal leaf-blade glabrous or scabrous by prickles, with a glabrous apex or with a an apical tassel of hairs 2

2. Lemma subdorsal and dorsal rows distinct; abaxial surface of the basal leaf-blade distinctly scabrous; leaf-blade apex usually glabrous; awn (9.6)12-25(28) cm long.....3
2. Lemma subdorsal and dorsal rows fused at the base; abaxial surface of the basal leaf-blade glabrous or somewhat scabrous; leaf-blade apex usually with an apical tassel of hairs; awn (21)26-34(36) cm long.....6

3. Glumes (3.5)4-5.6(6.5) cm long; awn (18)20-26(28) cm long and (0.4)0.6-0.7 mm in diameter.....4
3. Glumes (2.3)3.2-4.4(5.3) cm long; awn (9.6)10.4-18.4(20) cm long and (0.3)0.4-0.5 mm in diameter.....5

4. Anthecium (13.7)14.3-17.5(18.5) mm long; column (4.4)4.8-7(7.5) cm long; ligules (0.25)0.42-1.7(2.5) mm long.....**4. *S. kirghisorum***
4. Anthecium (11.9)12-14.6(14.8) mm long; column (1.7)2.3-3.8(3.9) cm long; ligules (2.3)2.8-9.8(10.2) mm long.....**3c. *S. turkestanica* subsp. *macroglossa***

5. Anthecium (8.3)9.6-11.9(12.2) mm long; awn (9.6)9.7-17(18.4) cm long; ligules of the basal leaves 1.6-5.8(6.7) mm long.....**3a. *S. turkestanica* subsp. *turkestanica***
5. Anthecium (11)11.5-14.4 mm long; awn (13.4)13.6-20.1(21.1) cm long; ligules of the basal leaves 0.5-1.4(1.5) mm long.....**3b. *S. turkestanica* subsp. *trichoides***

6. Callus (2.6)2.7-4 mm long; peripheral ring curved; peripheral ring width/ratio = (0.29)0.3-0.41(0.43). .....**2a. *S. pennata* subsp. *pennata***
6 Callus (3.8)3.9-5 mm long; peripheral ring straight; peripheral ring width/ratio = (0.23)0.24-0.32(0.36). .....**2b. *S. pennata* subsp. *sabulosa***

I. **Stipa** subsection **Tirsae** (Martinovský) R. Gonzalo, **stat. nov.** *Stipa* ser. *Tirsae* Martinovský, Preslia 48: 186. 1976.—TYPE: *Stipa tirsa* Steven

Stipa ser. *Stenophyllae* Klokov, Novosti Sist. Vyssh. Rast. 1975: 81. 1976.—TYPE: *S. stenophylla* (Czern. ex Lindem.) Trautv.

Herbs densely caespitose, perennial; branching intravaginal. Culms 3-4 noded, erect. Basal leaf-blade convolute; abaxial surface with sparsely stiff hairs; adaxial surface somewhat scabrous, minutely pubescent and with scattered hairs; ligules truncate up to 0.4 mm long. Panicles contracted, 3-4 noded, the first internode pubescent; branches erect or almost erect and with long hairs. Glumes equal or subequal, lanceolate, long acuminate, 3-7 nerved and with the central nerve usually ciliate. Anthecium coriaceous, fusiform or laterally compressed; lemma with 7 rows of hairs, the ventral rows of hairs ending 4.5 mm below the top of the lemma, the dorsal row and the subdorsal row slightly fused at the base, with the dorsal row longer or equalling in length the subdorsal row; callus acute, slightly curved, villous, scar elliptic, peripheral ring dorsally flattened and protruding. Palea lanceolate, two nerved and ± the lemma length; lodicules 3, equal or subequal, acute, membranous, lanceolate or linear-lanceolate. Awn bigeniculate; column glabrous; seta flexuous and plumose with hairs longer than 3.5 mm. Ovary glabrous, styles 2.

***Notes*—**Subsection *Tirsae*, includes only *S. tirsa*, a species widely distributed in Europe, Caucasus, South-western Russia, Northwest Kazakhstan and western Siberia. *Stipa tirsa* is morphologically closely related to species of subsect. *Stipa*. However, it has unique features, as the presence of a setaceous apex on the basal leaves, very short ligules, and the abaxial surface of the basal leaves with sparsely stiff hairs. Martinovský (1976) considered these features of enough relevance to create the series *Tirsae*, which is here combined as subsection.

1. *STIPA TIRSA* Steven, Bull. Soc. Imp. Naturalistes Moscou 30(2): 115. 1857; S. *pennata* var. *tirsa* (Steven) L. F. Čelak., Sitzungsber. Königl. Böhm. Ges. Wiss. Prag, Math.-Naturwiss. Cl. 1884: 58. 1884.—TYPE: UKRAINE. Kaltschik, camp. Maeotic, *Graff s.n.* (lectotype: H!, selected by Martinovský & Skalický 1969).

Stipa cerariorum Pančić, Fl. Knevez. Srbje: 738. 1874; *S. pennata* subsp. *cerariorum* (Pančić) K. Richt., Pl. Eur. 1: 32. 1890.—TYPE: SERBIA. Brestovac. Pančić *s.n.* (lectotype: W 1916 19486!, designated here).

Stipa pennata var. *stenophylla* Czern. ex Lindem., Fl. Cherson 2: 283. 1882; *S. stenophylla* (Czern. ex Lindem.) Trautv., Trudy Imp. S.-Peterburgsk. Bot. Sada 9: 351. 1884.—TYPE: UKRAINE. Charkov region, steppe near Rogan, 29 Jun 1853, *Czernajaev s.n.* (holotype: LE!).

Stipa schmiditii Woronow ex Grossh., Fl. Kavk. 1: 66. 1928.—TYPE: GEORGIA. Jalno Mts near Tiflis, 30 Jul 1919, *Schischkin s.n.* (lectotype: LE!, designated by Tzvelev 1976).

Stipa tirsa subsp. *albanica* Martinovský, Preslia 44: 22. 1972.—TYPE: ALBANIA. Septentrionali in monte Paŝtrik, 22 Jul 1918, *Doerfler s.n.* (holotype: LD!; isotypes: WU!, S!).

Herbs 20-60 cm high, perennial, caespitose; branching intravaginal. Culms 3-4 noded, nodes glabrous, violet; culm internode pubescent. Basal leaves 34-100 cm long, green, eventually pruinose; leaf-sheaths usually glabrous, margins glabrous (rarely ciliate); leaf-blades 28-57 cm long, (0.2)0.3-0.5 mm in diameter, convolute, abaxial surface distinctly scabrous by sparsely stiff hairs (0.03)0.09-0.25 mm long, adaxial surface somewhat scabrous, minutely pubescent and occasionally with scattered hairs, ending in a long setaceous apex; ligules 0.1-0.4 cm long, truncate, somewhat scabrous, ciliolate (rarely ciliate), cilia 0.01-0.08(0.29) mm long. Floriferous culm leaves 30-57 cm long; leaf-sheaths 24-50 cm long, somewhat scabrous with stiff hairs near the leaf-blades and the margins, and the remainder papillose, margins glabrous; leaf-blades 2.5-12 cm long, (0.19)0.2-0.32(0.36) mm in diameter, abaxial surface with sparsely stiff hairs, adaxial face papillose, minutely pubescent or pubescent, hairs (0.01)0.05-0.23(0.25) mm long; ligules (0.2)0.4-1,5(2.1) mm long, truncate, obtuse or rounded, somewhat scabrous or glabrous, margins glabrous or ciliolate, tip ciliolate (rarely glabrous), cilia (0.02)0.03-0.13(0.15) mm long. Panicles 6-37 cm long, contracted, enclosed or partially enclosed by the upper leaf-sheath, 3-4 noded; basal internodes

(0.4)0.7-18(25) cm long, pubescent; branches (0.9)1.6-3.2(3.7) cm long, erect or almost erect, setulose, setae (0.34)0.39-1.22(1.29) mm long; basal nodes with (1)2 branches with 1 spikelets each. Glumes subequal, lanceolate, long acuminate, glabrous with the central nerve usually ciliate, cilia (0.1)0.3-1(1.6) mm long, green with margins and tip hyaline, the lower (4.9)5.3-6.7(7) cm long and 3-5 nerved, the upper (4.7)5-6.5(6.7) cm long and 5-7 nerved. Anthecium (16.7)17.2-19.2(19.7) mm long, (0.8)0.9-1.3(1.4) mm wide, fusiform, coriaceus, pale or brown; lemma (12.7)13.3-15.5(16) mm long, near the apex glabrous, with 7 distinct rows of hairs or with the dorsal and subdorsal ones fused and the remainder rows free, the ventral rows ending (0.5)1.1-4.18(4.76) mm below the top of the lemma, the dorsal row measuring ± 1/2-1/3 the length of the lemma, the remainder rows shorter or equaling the dorsal row, rows with appressed to almost erect hairs (0.3)0.4-0.7 mm long; callus 3.4-4.2(4.3) mm long, acute, curved or slightly straight, villous, hairs (1.3)1.5-2.1(2.5) mm long on the ventral face and (0.8)0.9-1.2(1.5) mm long on the dorsal face, scar elliptic, peripheral ring (0.6)0.7-0.9(1) mm long, 0.25-0.33(0.35) mm wide (ratio width/length= 0.3-0.4(0.5)); palea (12)12.9-14.9(15.7) mm long, lanceolate, margins and tip hyaline, dorsally 2-nerved, between the two nerves papillose or glabrous (rarely with a dorsal row of hairs up to 1/4 the length of the palea), margins and tip glabrous (rarely ciliate), brown or green; lodicules 3, equal or subequal, with the dorsal ones slightly longer or shorter than the ventral one, acute, lanceolate or linear-lanceolate, membranous, glabrous, dorsal lodicules (2)2.5-3.7(4.9) mm long, ventral lodicule (1.7)2.1-3.9(4) mm long. Awn (31)34-43(45) cm long, bigeniculate; column (5.2)6.3-9(9.3) cm long, base (0.42)0.48-0.64(0.66) mm in diameter, twisted, brown or brown and green, glabrous; geniculation (1.3)1.4-2.2(2.4) cm long, glabrous; seta (23.3)25.5-35.5(36.5) cm long, (ratio column length/seta length = (0.18)0.22-0.34(0.36)), flexuous, plumose, hairs in lower part (4)4.4-6.2(6.7) mm long. Anthers (5.2)5.7-8.7(9.6) mm long, glabrous. Ovary glabrous, styles 2. Caryopsis (9.5)9.6-11.5(11.9) mm long, fusiform; embryo 1.5-2.6(2.7) mm long. (Fig. 7).

Chromosome Number—2*n*= 44 (Tzvelev 1976; Freitag 1985; Conert 1982).

Distribution and Habitat—Inhabits stony and dry slopes, pastures, forest glades, mountain meadows, and steppes from sea level up to middle mountains belts, 0-2300 m. It is roughly distributed from Central, North, South and East Europe to Southwest Siberia (Omsk, Kuban and Tyumen provinces). Likewise, it has been scattered found in Central and South France, North Italy, North Caucasus, Transcaucasia, Northeast Turkey, and in the Caspian Area of Kazakhstan (central Asia). *Stipa tirsa* has been also reported from Bulgaria (Dimitrov 2002: 357). Unfortunately, it was not possible to examine the specimens supporting this record. One sheet from Spain has been identified as *S. tirsa*: "Se cría en montes y colinas áridas cerca de Madrid, Aranjuez, Mancha y Reyno de Murcia, *Lagasca, s.n.* (MA)". Paunero (1960) recognized this species for Spain; however, considering its general distribution and that no other specimens have been collected since Lagasca (Vázquez and Devesa 1996), this reference probably represents a labelling mistake. (Fig. 8).

Phenology—Flowering specimens have been collected in May, June and July.

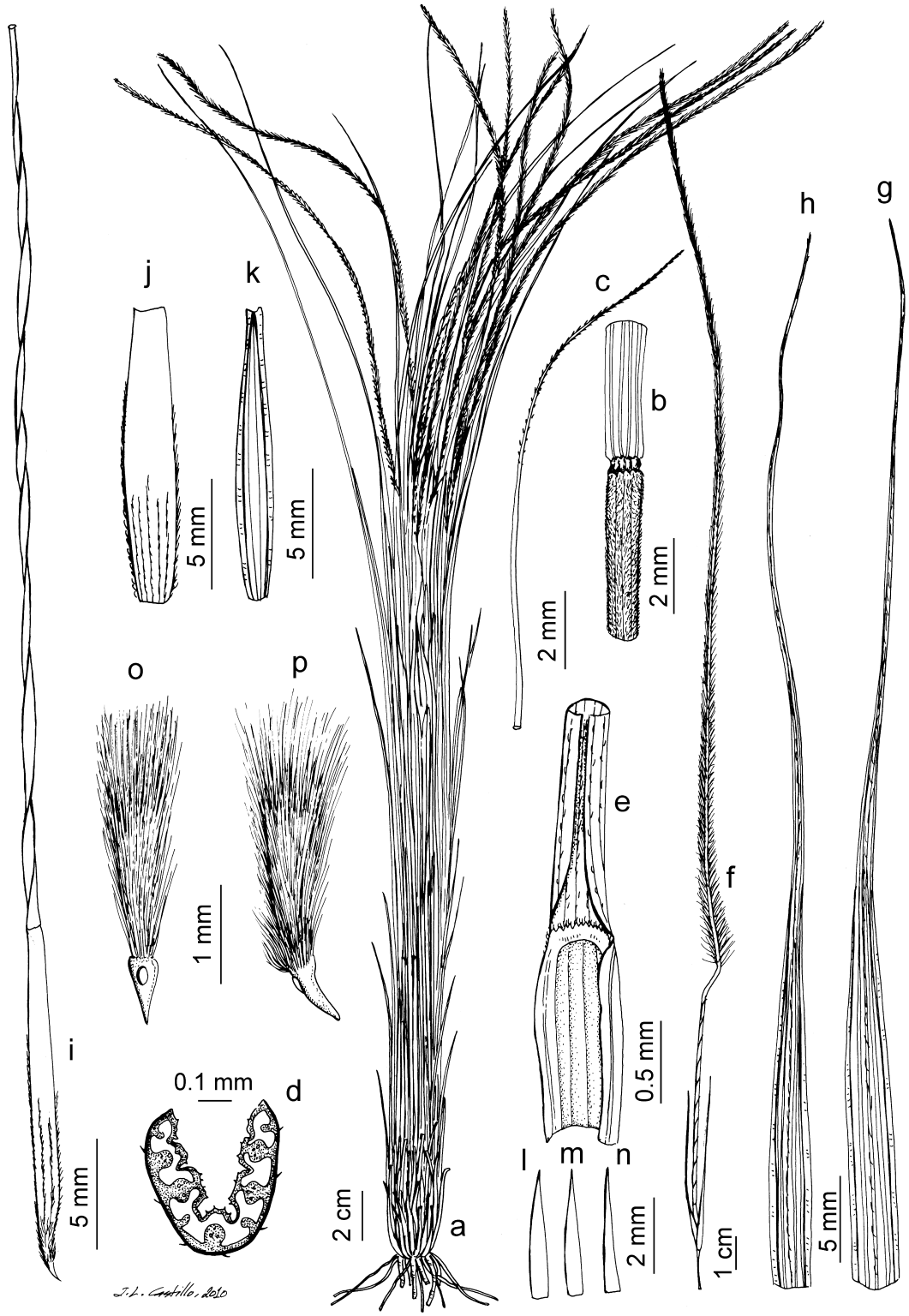


FIG. 7. *Stipa tirsa.* a. Habit. b. Culm node. c. Basal leaf apex. d. Transversal section of leaf-blades. e. Basal leaf ligule. f. Spikelet. g. Upper glume. h. Lower glume. i. Anthecium and column. j. Lemma. k. Palea. l, m. Dorsals lodicules. n. ventral lodicule. o. Callus, ventral view. p. Callus, lateral view. [based on: *Weber s.n.* 20 May 1932 (MA 4987(2)].

***Representative Specimens Examined*—**ALBANIA. Kukés: Albania septentrionali in monte Pâstrik, 42° 13′ N 20° 30′ E, 22 Jul 1916-1918, *Doerfler 866* (S, WU). ARMENIA. Aragatsotn: Monte Aragat, Ghazaravan, road to Kari lake, 40° 23′ N 44° 15′ E, 30 Jun 2005, *Medina et al. 2591* (MA). Gegharkunik: Krasnoselskoie district, montes Areguni in vicinitate pagi Tokludza, 40° 34′ N 45° 15′ E, 31 Jul 1975, *Vasak s.n.* (MA, WAG). AUSTRIA. Niederösterreich: Weinviertel. Mortz ner World. Sriolhorf, 48° 23' N 16° 40' E, 10 Jun /15 Jul 1962, *Melzer s.n.* (BR, GZU, W). AZERBAIJAN. Nakhchivan: Prope pag. Bist, 39° 8′ N 45° 52′ E, 27 Jul 1931, *Prilipko & Vichert s.n.* (LD). CZECH REPUBLIC**.** Jihočeský kraj: Krumlov versus Rokytno, 48° 49′ N 14° 19′ E, 6 Jul 1926, *Podpěra s.n.* (JE). Jihomoravský Kraj: Montes Bilé Karpaty. Vyzkum prope vicum Tasov, 48° 52′ N 17° 27′ E, Jun 1935, *Weber s.n.* (BR, H, W); Vyškov: in declivibus stepposis collis Větrníky supra pagum Lysovice, 49° 13′ N 16° 58′ E, 17 Jun 1960, *bad handwriting s.n.* (LD); Umgebung von Moravsky Krumlov, SW-Hang des Berges Křížová hora über dem rechten Ufer des Ro-kytná-Flusses, 49° 3′ N 16° 29′ E, 14 Jul 1986, *Pokorny & Strudl s.n.* (W). Karlovarský Kraj: Kobylé, 50° 4′ N 13° 14′ E, 30 Jun 28, *Colrube s.n.* (JE); Milejové louky, ad p. Hluk, district Uh. Ostroh, 50° 8′ N 12° 17′ E, 13 Jun 1926, *Otruba 165* (BR, H, S, WU). Moravskoslezský Kraj: Werte, Karpaten, Steppenabhänge C.M. Vrbka, 49° 59′ N 18° 1′ E, Jun 1934, *Laus s.n.* (MA); Werte, Karpaten, Kobylslava, 50° 8′ N 17° 38′ E, Jul 1933, *Laus s.n.* (MA). Středočeský Kraj: Vetruiky bei Bucovice, 49° 38′ N 14° 33′ E, 5 Jul 1911, *Colrube s.n.* (JE); Rosendals, 50° 10′ N 14° 23′ E, Jul 1865, *Kugelberg s.n.* (S); Deblik, 50° 35′ N 14° 3′ S, Jun 1912, *Missbach s.n.* (S). Ústecký Kraj: Böhmen: Abhänge der Radobyl bei Leitmeritz, 50° 32′ N 14° 8′ E, 10 Jun 89, *Hora s.n.* (S); Saaz, bei Trnowan auf der Anhöhe, 50° 33′ N 14° 11′ E, 20 Jul 1886, *Celakovský s.n.* (WU). Vysočina: Větrníky ad urbem Vyškov, 49° 14′ N 15° 33′ E, 13 Jun 1926, *Podpěra & Jirásek 165* (BR, H, S, U, W, WU); Mahren vid Mohelno, 49° 7′ N 16° 11′ E, 3 Jul 1936, *Anderberg s.n.* (UPS). Zlínský Kraj: Luhačovice, 49° 6′ N 17° 46′ E, 15 Jul 1928, *Regel s.n.* (G); Montes Bilé Karpaty, Hájová prope Lípov, 49° 7′ N 17° 53′ E, 11 Jun 1932, *Weber 384* (H, M, NY, W). FRANCE. Auvergne: Tournemire. Sur le plateau de Larrac, 45° 3′ N 2° 25′ E, 7 Jun 1905, *Frame s.n.* (MA). Bourgogne: Saône et-Loíre, 46° 40′ N 4° 30′ E, 23 Jun 1948, *Bonnot s.n.* (L). Île-de-France: Fontainebleau, 48° 24′ N 2° 42′ S, Jun 1844 (BR, MA). GEORGIA. Kakheti: Sagaredjo District, Iori plateau, David Garedji, 41° 28′ N 45° 16′ E, 16 May 2005, *Lachashvili 29* (W). Tiblisi: Jalno Mts near Tiflis, 41° 43' N 44° 47' E, 30 Jul 1919, *Schischkin s.n.* (LE). GERMANY. Rheinland-Pfalz: Bad Kreuznach; Nahetal, Martinstein, Flachsberg, 7° 32′ N 49° 48′ E, 9 Jul 1978, *Kalheber 78-464* (H); Near valley: Martinstein, 49° 48′ N 7° 31′ E, 21 Jun 1967, *Schumacher, A. s.n.* (H); Sachsen-Anhalt: Ostlich von Questenberg, 51° 29′ N 11° 7′ E, 13 May 1894, *Quelle s.n.* (JE); Halle: Lunz berg bie Lettin, 50° 32′ N 11° 55′ E, 20 Jun 1965, *Meyer & Lippold s.n.* (JE); Quedlinburg, Harslebener Berge zwischen Wsterhausen und Harsleben, 51° 52′ N 11° 6′ E, 20 Jun 1976, *Meyer & Manitz s.n.* (JE). Thüringia: Kyffhäuser, Fremkemburg, 51° 23′ N 11° 5′ E, 23 Jun 1960, *Bisse s.n.* (JE); Steigerthal. Harz, 51° 21′ N 10° 52′ E, Jun 1910, *Alpers s.n.* (S). GREECE. West Macedonia: Nomos Grevena. Vurinos, Südhange entlang der Straße von Palaeokastron nach Chromion. Zwischen Palaeokastron und Exarkhos, 40° 10′ N 21° 38′ E, 25 Jun 1985, *Lippert 20891* (M). HUNGARY. Baranya: Montis Kisköhegy prope Szentendre, 46° 9′ N 18° 6′ E, 21 Jun 1939, *Borós s.n.* (S, W). Fejér: Pap Irtás prope Csákvár, 47° 24′ N 18° 27′ E, 28 Jun 1937, *Borós s.n.* (W). Heves: Motnis Sarhegy supra Gyöngyös, 47° 47′ N 19° 58′ E, 21 Jun 1902, *Degen 252* (JE, W, WU). Nógrád: In monte Hármashatárhegy (Drei Hosserberg), 48° 0′ N 19° 40′ S, 7 Jun 1897, *Borbás s.n.* (PR). Pest: Háromhatárhegy ad urbem Budapest, *Simonkai 3990* (GH, H, JE, L, LU, PR, S, W, WU); In declivibus orientalibus, montis Harmus határhegy supra Ó-Buda, 47° 33′ N 19° 2′ E, 1 Jun 1904, *Degen 352* (W); Budae-Pestini; in montibus Aquinci, 47° 34′ N 19° 4′ E, 4 Jun 1897, *Borbás s.n.* (W, WU); Izbég, 47° 41′ N 19° 4′ E, 20 May 1916, *Degen s.n.* (S); Montis Kis Szenús supra Pilis-Szentivan, 47° 37′ N 18° 54′ E, 21 May 1916, *Degen s.n.* (WAG). ITALIA. Lombardia: Rezzato (Brescia at sud), 45° 31′ N 10° 19′ E, 15 Jun 1984, *Moraldo s.n.* (Herb. Moraldo, digital image). Toscana: Alta valle Tiberina: intorno al torrente Sovare, 43° 33′ N 12° 12′ E, 20 Jun 1984, *Moraldo s.n.* (FI). Alta valle Tiberina: Monticello quoa m 466 sotto Cammiano, 27 Jun 1937, *Zermetti s.n.* (W). KAZAKHSTAN. Kostanay: Kustanayskiy. Fedorovskiy rayon. Steynoy, 52° 17′ N 65° 21′ E, 19 Jun 1930, *Kuznezow 310* (NY). MACEDONIA. Vardar: Monte Snha planina prope Drzilovo, 41° 51′ N 21° 20′ E, 27 Aug 1922, *Vandas s.n.* (PR). MOLDOVA. Cimislia: Chimshiliyskiy District, Zlotyi village, 46° 41′ N 28° 53′ E, 11 Jun 1958,

Botezoni s.n. (LE). ROMANIA. Alba: Mühlbach, 45° 58´ N 23° 34´ E, 22 Jun 1906, *Barth s.n.* (B, JE, M, U, W). Cluj: Techintău ad Fânatele Clujului, 47° 32´ N 23° 46´ E, 8 Jun 1927, *Nyárády 1340* (BR, K, H, S); Cheia, pr. Cheile Turzii, 46° 18´ N 23° 27´ E, 14 Jul 1998, *Güemes & Bacchetta 2510* (C, MA); Aud dem Berge Suškuluj bei Herkulesbad im banata, 44° 52´ N 22° 24´ S, 1 Jul 1902, *Richter 313* (WAG). RUSSIA. Astrakhanskaya Oblast: Prov. Tambow, in steppa Jamskaja prope pag. Streletzkaja, 47° 19´ N 47° 22´ E, 29 May 1929, *Smirnow 4902a* (H, W). Bashkortostan: Zilair District, between Tukatov and Shafeevskiy villages, 52° 27´ N 56° 47´ E, 14 Jul 1928, *Knorring 341* (JE); Region Bashkiria, district Abzelilov, Bakr-Uzyak village, 52° 59´ N 58° 38´ E, 8 Aug 1949, *Khokhryakov & Mazurenko s.n.* (W). Krasnodarskiy Kray: Kuban prov. Tamanskiy peninsula S shore of the liman Isokur opposit Steblivskoj, 45° 11´ N 36° 48´ E, 23 Jul 1926, *Schiffers 2138* (S). Kurgan: Between Obryadovka and Kungurovka, 54° 43´ N 65° 13´ E, 19 Jul 1928, *Ivanova & Tonshina 704* (LE); Lopatinskiy District, Stepnaya village, 55° 7´ N 67° 3´ E, 21 Jul 1928, *Ivanova & Tonshina 1193* (LE). Novosibirskaya Oblast: Turcia, inter opp. Sarykamysh et pag. Promezhutocznoje, 50° 44´ N 80° 34´ E, 5 Jul 1914, *Litvinov 4902b* (C, H, K, JE, S, W). Omsk: Poltavskiy District, Poltavskoye village, 54° 25´ N 71° 40´ E, 22 May 1949, *Vandakurova s.n.* (LE). Penzenskaya: Kuchkino district near Poperechnaya village. Privolzhaskaya Vozvyshennost´Reserve (Volga upland reserve). Poperechenskaya Steppe, 53° 0´ N 44° 30´ E, 6 Jul 1951, *Bunyashina s.n.* (K). Rostov: Novotscherkassk, 47° 52´ N 40° 5´ E, 26 May 1910, *Jakouschev s.n.* (M); Millerovo, the 4st department of Millerovo sovhoz, 2.5 km to NE from the estate, S slope of ravine Medvezhya, 48° 55´ N 40° 23´ E, 4 Jul 1939, *Kurlyushkin s.n.* (LE). Saratov: Ivanteevka reg., 10 Km N of Ivanteevka, near settlement Znamenskyi, 52° 20´ N 49° 8´ E, 7 Jul 1993, *Skvortsov et al. s.n.* (LE); Vicinity of Saratov, between Bol´shaya, Polivanovka and Fedorovka, 51° 34´ N 45° 53´ E, 16 Jun 1922, *Kazakova s.n.* (LE). Voronezh: Distr. Novochopersk, prope Kalinovka, 51° 25´ N 41° 35´ E, 17 Jun 1963, *Skvortsov s.n.* (M). SERBIA. Serbien, *Ilić, s.n.* (WU); Serbia Breslovac, *Pančić s.n.* (W). In apricis ad Breslovac Banja, 44° 03´ N 22° 02´ E, *Pančić s.n*. (W). SLOVAKIA. Prešov Region: Vová Baria; in declivibus merid. collis Kliča supra pag. Sr. Benedik, 49° 14' N 21° 33' E, 3 Jul 1938, *Krist s.n.* (JE, LD). Trenčín Region: Montes Bile Karpaty, in declivibus collis Hájora, 49° 0´ N 18° 0´ E, 20 May 1932, *Weber, s.n.* (MA). TURKEY. Ardahan: Osttürkei: Steppe am Cildir-Gölü, 41° 7´ N 43° 8´ E, 1 Jul 1991, *Lang s.n.* (M); Hucgel bei Atsihikler bei Smonk, 6 Jun 1896, *Callier 219* (PR); Agri: Distr. Erzurum/Agri: Tahir-Pab, 20 Aug 1971, *Volk 71/604* (M). UKRAINE. Kharkiv: Charcovia, 49° 9´ N 36° 3´ E, 1853-1854, *Czern. s.n.* (MEL). Krym: Karadag. The NE slope of Legener mountain, 44° 56´ N 35° 13´ E, 10 Jul 1928, *Chernova 209* (W); Mountain Ay-Petri, 44° 29´ N 34° 3´ E, 9 Aug 1948, *Golubkova 1221* (LE); Luhansk: Elevatio Donetz, Provalje, prope st. viae ferreae Krasnaja mogila, 48° 10' N 39° 51' E, 26 Jun 1928, *Smirnow 40* (H, JE, S); Distr. Starbelsk, 49° 16´ N 38° 54´ E, 10 Jun 1903, *Skvortsov s.n.* (M); Distr. Meloviensis, reservatum"Striletzjkyj step" dictum, 12 Jun 1957 48° 28´ N 39° 44´ E, *Dubovik s.n.* (NY).

***Notes*—**The basal leaves of *S. tirsa* present a setaceous apex, very short ligules, and the abaxial surface of the basal leaves with sparsely stiff hairs, allowing this species to be distinguished from its closest relatives. However, a few narrowed leaved specimens of *S. zalesskii* Wilensky migth be confused with *S. tirsa*. However, the ligules in *S. zalesskii* are always more developed and the basal leaves are scabrous by both prickles and long and erect-spreading stiff hairs, whereas prickles are missing in *S. tirsa*.

Martinovský (1972) described *Stipa tirsa* subsp. *albanica* from Paštrik and Djakovo in Albania, characterized by having the ventral rows reaching the apex of the lemma and the other rows longer than half the lenght of the lemma. A careful observation of the three type specimens in LD, S and WU revealed that the holotype (LD) presents the ventral rows ending 0.5 mm below the apex, while the other rows are longer than half the length of the lemma. The isotypes deposited in S and WU herbaria have the ventral rows ending 1.5 mm below the apex and the other rows reach about half the length of the lemma or they are shorter. Likewise, other specimens with ventral

rows ending ca. 1.5 mm below the top of the lemma apex have also been collected in Germany, Romania, and Czech Republic. Therefore, the relative length of the rows is variable, not supporting Martinovský´s view of a separate subspecies.

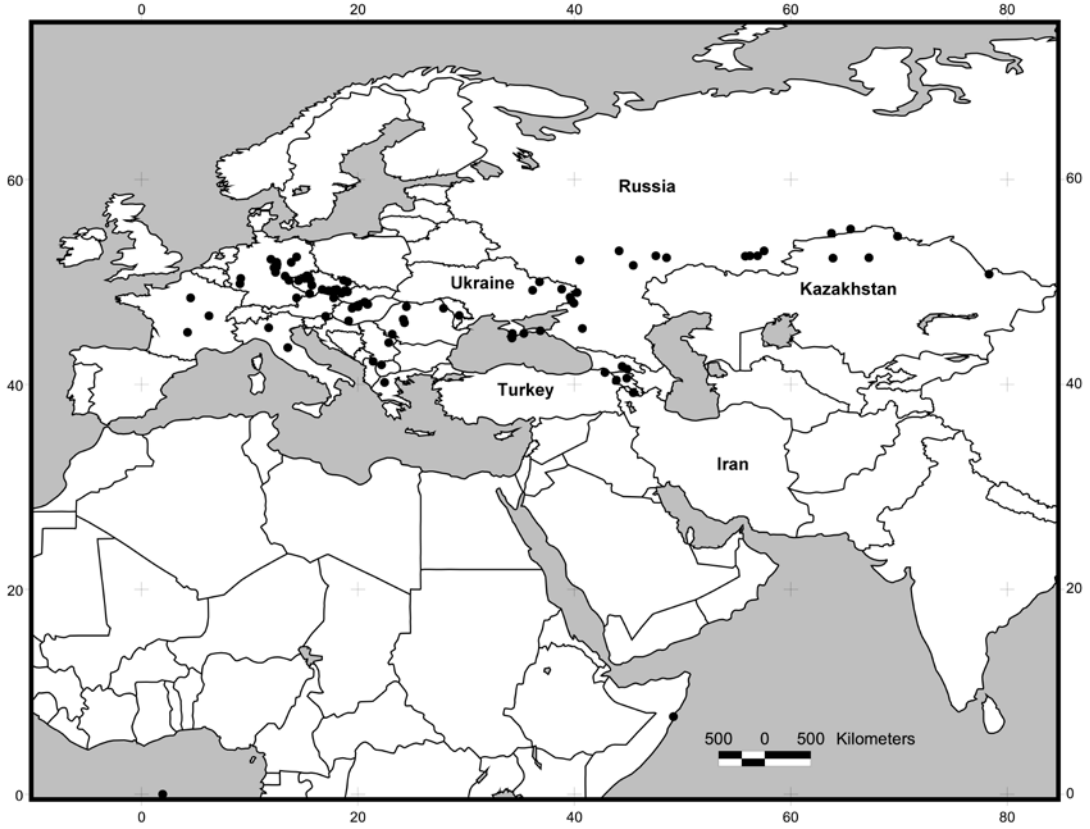


FIG. 8. Distribution map of *S. tirsa* (●).

II. STIPA subsection STIPA L.—TYPE: *Stipa pennata* L.

Stipa ser. *Pennatae* Roshev in Komarov (ed.), Fl. URSS 2: 92. 1934.—TYPE: *Stipa pennata* L.

Stipa subser. *Penicilliferae* Martinovský, Oesterr. Bot. Z. 118: 172. 1970.—TYPE: *Stipa joannis* L. F. Čelak

Stipa ser. *Penicilliferae* Martinovský, Preslia 48: 187. 1976.—TYPE: *Stipa joannis* L.

Stipa ser. *Anomalae* Klokov, Novosti. Sist. Vyssh. Nizsh. Rast. 1975: 29. 1976.—TYPE: *Stipa anomala* P.A. Smirn.

Herbs densely caespitose, perennial; branching intravaginal. Culms 3-4 noded, erect. Basal leaf-blade convolute; abaxial surface glabrous, distinctly scabrous or minutely scabrous; adaxial surface scabrous, minutely pubescent or with scattered hairs; ligules acute, obtuse or rounded. Panicle contracted, 3-4 noded, the first internode glabrous, scabrous (rarely pubescent or with sparsely hairs); branches erect or almost erect and sparsely setulose. Glumes equal or subequal, lanceolate, long acuminate, 3-7 nerved and with the central nerve sometimes ciliate. Anthecium coriaceous, fusiform or

laterally compressed; lemma with 7 distinct rows of hairs, or with the dorsal and subdorsal rows of hairs slightly fused at the base, the ventral rows of hairs ending 7 mm below the top of the lemma, the dorsal row and the subdorsal row slightly fused at the base and with the dorsal row longer or at most equaling in length the subdorsal row; callus acute, curved or straight, villous, scar elliptic, peripheral ring dorsally flattened and protruding. Palea lanceolate, two nerved and ± the lemma length; lodicules 3, equal or subequal, acute, membranous, lanceolate or linear-lanceolate. Awn bigeniculate; column glabrous or scabrous (rarely pilose); seta flexuous and plumose, hairs longer than 3.5 mm. Ovary glabrous, styles 2.

2. STIPA PENNATA L. Sp. Pl.: 78. 1753. TYPE: Ind. loc.:"Habitat in Austria, Gallia" (lectotype: L 900.320-437 Herb A. van Royen, selected by Freitag, 1985, digital image!).

Herbs 21-76 cm high, perennial, caespitose; branching intravaginal. Culms 2-3 noded, nodes glabrous, violet; culm internodes usually glabrous. Basal leaves 15-83 cm long, green and occasionally pruinose; leaf-sheaths glabrous, papillose, scabrous or pubescent, margins glabrous or ciliate; leaf-blades 8-66 cm long, (0.36)0.41-0.77(0.98) mm in diameter, usually convolute, abaxial surface glabrous or scabrous, adaxial surface scabrous, pilose or with scattered hairs (0.06)0.18-0.56(0.77) mm long, apex acute, glabrous, setulose or with an apical tassel of hairs 0.5-3 mm long; ligules (0.5)0.93-2.5(3.1) cm long, acute, obtuse or rounded, glabrous or scabrous (rarely pilose), margin glabrous or ciliolate (rarely ciliate), cilia (0.01)0.09-0.2 mm long. Floriferous culm leaves 22-51 cm long; leaf-sheaths 22-50 cm long, minutely scabrous, papillose or glabrous, margins glabrous; leaf-blades (0.4)1-5.4(12) cm long, (0.1)0.15-0.39(0.49) mm in diameter, abaxial surface glabrous, somewhat scabrous or sparsely aculeate, adaxial face scabrous, pilose or scabrous with scattered hairs (0.07)0.08-0.4(0.42) mm long; ligules (0.2)0.7-3.8(11.2) mm long, acute, obtuse, rarely truncate or bifid, glabrous, scabrous, sparsely aculeate or sparsely pilose, margins glabrous, ciliolate or ciliate, cilia (0.02)0.05-0.3(0.33) mm long. Panicles 13-52 cm long, contracted, enclosed or partially enclosed by the upper leaf-sheaths, 3-6(8) noded; basal internode (6.2)17-39(48) cm long, glabrous, scabrous (rarely pubescent); branches 1.4-5(6) cm long, erect or almost erect, glabrous, scabrous, setulose or sparsely setulose, setae (0.02)0.-0.8(1.2) mm long; basal nodes with (1)2(3) branches with 1-2 spikelets each. Glumes subequal, lanceolate, long acuminate, glabrous, rarely ciliate on the central nerve, cilia 0.05-1 mm long, green with margins and tip hyaline, occasionally with purple stains, the lower (3.2)4.3-6(8) cm long and 3-5 nerved, the upper (3)4.1-6(7) cm long and 5-7 nerved. Anthecium (13.4)15.5-19(21) mm long, (0.6)0.8-1.2(1.4) mm wide, fusiform, coriaceous, pale, brown or green; lemma (10.8)12.3-15(16.1) mm long, near the apex glabrous, with 7 rows of appressed to almost patent hairs (0.3)0.4-0.7(1) mm long, the dorsal row and subdorsal ones fused at the base and the remainder rows free, the ventral rows ending (2.5)3.6-6.2(7) mm below the top (rarely ending (0.4)0.5-1(1.2) mm below the top), the dorsal row measuring 1/2 as long as the lemma

and quite longer than the subdorsal rows; callus (2.62)2.9-4.4(5) mm long, acute, curved or straight, villous, hairs (1.2)1.6-2.6(2.9) mm long on the ventral face and (0.7)0.8-1.5(1.6) mm long on the dorsal face, scar somewhat circulate to broadly elliptic, peripheral ring (0.65)0.74-0.98(1.05) mm long, (0.2)0.22-0.32(0.38) mm wide (ratio width/length= (0.23)0.25-0.4(0.43)); palea (9)11.9-14.3(15.5) mm long, lanceolate, membranous, margins and tip hyaline, dorsally 2-nerved, between the two nerves papillose or glabrous, margins glabrous and tip glabrous or ciliate, rarely with a dorsal row of hairs up to 1/3 the length of the palea, pale brown, brown or green; lodicules 3, equal or subequal, with the dorsal ones slightly longer or shorter than the ventral one, acute, lanceolate or linear lanceolate, membranous, glabrous (rarely ciliate at the apex), dorsal lodicules (1.5)1.7-3.3(3.7) mm long, ventral lodicule (1)1.6-3.4(3.7) mm long. Awn (21)26-34(36) cm long, bigeniculate; column (4.8)5.5-8(9.2) cm long, base (0.35)0.44-0.57(0.63) mm in diameter, twisted, brown, brown and green, and frequently with purple stains, glabrous (rarely pilose); geniculation (1.3)1.4-2.2(2.4) cm long, glabrous, scabrous, more rarely pilose; seta (16)19.8-28.1(29.4) cm long, (ratio column length/seta length = (0.18)0.22-0.34(0.47)), flexuous, plumose, hairs in lower part (4)4.6-6.1(7.9) mm long. Anthers (4.1)4.4-8(8.4) mm long, glabrous (rarely with scattered hairs), yellow or purple. Ovary glabrous, styles 2. Caryopsis (8.3)9-11.2(11.6) mm long, fusiform; embryo (1.3)1.5-2.2(2.7) mm long.

a. subsp. PENNATA L.

Stipa aperta Janka ex L.F. Čelak., Oesterr. Bot. Z. 33: 318. 1883; *S. pennata* [c] *aperta* Asch. & Graebn., Syn. Mitteleur. Fl. 2: 105. 1899.—TYPE: CZECH REPUBLIC. Inter Mócs et Izombasselke. Trasnilvaniae centralis, 1 Jun 1869, *Janka s.n.* (neotype: W!, designated here).

Stipa joannis L.F. Čelak., Oesterr. Bot. Z. 34: 318. 1884; *S. pennata* [α] *joannis* (L.F. Čelak.) Beck, Fl. Nieder-Österreich: 50. 1884; *S. pennata* [A] *joannis* (L.F. Čelak.) Asch. & Graebn., Syn. Mitteleur. Fl. 2: 105. 1899; *S. pennata* subsp. *joannis* (L.F. Čelak.) Pacz., Zlaki Khers. Gub. 1913; *S. pennata* subsp. *joannis* (L.F. Čelak.) Hyl., Bot. Not. 1953: 354. 1953., comb. superfl.—TYPE: CZECH REPUBLIC. In dem romantischen St. Joansthale unweit Karkstein bei Prag wachst sie um die Felsenhohle des hlg. Jvan, *Johannes s.n.* (type: original material not located).

Stipa pennata [III] *mollis* Czern. ex Asch. & Graebn., Syn. Mitteleur. Fl. 2: 107. 1899; *Stipa pulcherrima* var. *mollis* (Czern. ex Asch.) B. Fedtsch., Izv. Imp. Bot. Sada Petra Velikago. 14 (Suppl.): 48. 1915.—TYPE: UKRAINE. Charkow, *Czerniaw s.n.* (neotype: W 1916 26187!, selected here).

Stipa lejophylla P.A. Smirn. Uchen. Zap. Mosk. Univ. 2: 335. 1934; *S. pennata* subsp. *lejophylla* (P.A. Smirn.) Tzvelev, Novosti Sist. Vyssh. Rast. 11: 18. 1974.—TYPE: ARMENIA. Prope pag. Karadshoran, in vulcano Karny Janych, 9 Aug 1929, *Smirnow s.n.* (lectotype: MW, selected by Smirnow, 1970; isolectotype: B!, JE, E!, H!, LE!, S!, WU!).

Stipa danubialis Dihoru & Roman, Rev. Roumaine Biol., Sér. Bot. 14: 26. 1969.—TYPE: ROMANIA. In saxosis lapidosis ad ripas Danubii inter pagos Gura Văii et Dudaşul Schelii dictos, prope opp. Turnu-Severin (distr. Mehedinţi), *Savulescu s.n.* (holotype: BUCA digital image!).

Stipa styriaca var. *melzerii* Martinovský, Oesterr. Bot. Z. 118: 179. 1970; *S. melzerii* (Martinovský) Klokov, Novosti Sist. Vyssh. Nizsh. Rast 1975: 67. 1976.—TYPE: AUSTRIA. Bei Pölshof nahe von Pöls auf trockenem Hang und an Felsen, 24 Jun 1964, *Melzer s.n.* (holotype: GZU!).

Stipa styriaca Martinovský, Oesterr. Bot. Z. 118: 179. 1970. —TYPE: AUSTRIA. Bei Pöls ob Judenbergauf der Südseite des Lausbichls, 24 Jun 1964, *Melzer s.n.* (holotype: GZU!).

Stipa joannis subsp. *balcanica* Martinovský, Oesterr. Bot. Z. 118: 181. 1970; *S. balcanica* (Martinovský) Kožuharov, Opred. Vissh. Rast. Bulg.: 786. 1992.—TYPE: MONTENEGRO. In monte Ljut supra coeneb. Piva, Jul 1905, *Rohlena s.n.* (holotype: PRC digital image !).

Stipa graniticola Klok., Novosti Sist. Vyssh. Rast. 1975: 68. 1976.—TYPE: UKRAINE. Village Semenovkaon Bug, 9 May 1909, *Pachoskii s.n.* (holotype: KW).

Stipa disjuncta Klok., Novosti Sist. Vyssh. Rast. 1975: 75. 1976.—TYPE: UKRAINE. Dit. Sumensis, distr. Czervonensis, P.Studenok, 7 Jun 1954, *Klokov s.n.* (holotype: KW)

Herbs 21-76 cm high. Basal leaves 19-83 cm long. Leaf-blades abaxial surface glabrous, minutely scabrous or scabrous, adaxial surface scabrous, scabrous with sparsely long hairs or pilose, leaf-blades apex with an apical tassel of hairs almost at young leaves (rarely glabrous). Culms leaf-sheaths glabrous, papillose or minutely scabrous. Glumes 3-4.1-5.8(6.3) cm long. Anthecium (13.4)15-18(19) mm long; lemma (10.8)12.4-14.5(16) mm long, with seven rows of hairs, the dorsal and subdorsal row slightly fused at the base and the remainder rows free, the ventral ones ending (3.4)3.5-5.7(6.3) mm long below the top of the lemma, the dorsal row ending (4.3)6.5-9(10) mm below the top and longer than the subdorsal ones. Callus (2.6)2.7-4 mm long (callus/lemma= (0.18)0.2-0.27(0.3)), villous, scar elliptic, curved, peripheral ring (0.6)0.72-1 mm long, (0.2)0.25-0.36(0.38) mm wide (ratio width/length= (0.29)0.3-0.41(0.43)). Awn (21)26-34(36) cm long. (Fig. 9 m-v)

Chromosome Number—2*n*= 44 (Sheidai et al. 2006; Tzvelev 1976; 44 Freitag 1985).

Habitat and Distribution—Dry and stony slopes, pastures, mountain meadows, steppes, and open forest glades from lowlands up to middle mountain belts (rarely in alpine or subalpine communities), 100-4000 m. This species is widely distributed from Western Europe to Central and West Siberia, being especially abundant in steppes and xeric habitats of Central and Western Europe, whereas it is rare in East Kazakhstan,

Tajikistan, and Siberia. *Stipa pennata* subsp. *pennata* is also found in isolated areas of Xinjiang and West Mongolia. One specimen from Spain, collected in Sierra Nevada by Willkomm and preserved in MEL herbarium, has been identified as *S. pennata* subsp. *pennata*. But after studying hundreds of specimens from Sierra Nevada none of them has been identified as *S. pennata*. Considering its area of distribution (Fig. 10), it looks quite improbable that *S. pennata* actually grows in Spain. Therefore, Willkomm's record is likely a labelling mistake.

Phenology—Flowering specimens have been collected in May, June, July and August.

Representative Specimens Examined—ALBANIA. Dibër: Corab. Albania, 41° 46′ N 20° 32′ E, Jul 1908, *Dimonie, s.n.* (W, WU). ARMENIA. Ararat: Vedinskiy District, villages Azizkend and Dainag, the right shore of Vedi, 39° 57′ N 44° 57′ E, 27 May 1960, *Gabrielan et al. s.n.* (MA, MSB). Kotayk: Hrazdan distr., valley of river Hrazdan Bjni, SE above village, 44° 39′ N 40° 27′ E, 17 Jun 2004, *Fayvush et al. 04-0516* (W).Yerevan: Prope Karadshoran, in vulcano Karnyjarych, 40° 24′ N 44° 28′ E, 9 Aug 1929, *Smirnow 101* (B, H, S, W, WU); Caucasus, distr. Razdan, clivi montis Ketandag in vicinitate pagi Charencavan, 40° 30′ N 44° 40′ E, 7 Jul 1975, *Vašak s.n.* (W). AUSTRIA. Burgenland: Neusiedler See-Gebiet: Ober dem See (Oberseewald), etwa 3 km S St. Margarethen, 47° 51′ N 17° 0′ E, 28 May 1972, *Döbbeler 241* (M); Neusiedler-See, zwischen Weiden und Gols, 47° 50′ N 16° 45′ E, 17 May 1928, *Ronniger s.n.* (H); Steppe nördlich von Podersdorf am Neusiedlersee, 47° 53′ N 16° 52′ E, 29 May 1955, *Höpflinger s.n.* (C, W); Hornstein, Bges, 47° 52′ N 16° 26′ E, 20 May 1923, *Schneider s.n.* (W). Niederösterreich: Pfaffstätten, Baden, 48° 1′ N 16° 14′ E, Jun 1961, *Dulfer s.n.* (MA, W); Deustsh-Wagram. (Marchfeld, NO in einem mit Gras benachsenen Laubwald, 48° 15′ N 16° 40′ E, 3 May 1964, *Lang s.n.* (W); Rodan bei Perchtolsdorf, 48° 7′ N 16° 16′ E, 16 May 1931, *Jurisic s.n.* (W); Perchtoldsdorf in Nied.Oesterreich, 48° 7′ N 16° 16′ E, n.d., *Keik s.n.* (C); Wien, Lobau, 47° 50′ N 16° 50′ E, 27 May 1936, *Ronniger s.n.* (W); Thaya bei Raabs, 48° 85′ N 15° 5′ E, 3 Jul 1877, *Krenberger s.n.* (WU); Kamptal unterhalb Gars, Zitternberg (7459/2), 48° 35′ N 15° 14′ E, 8 Jun 1982, *Pokorny & Strudl s.n.* (W). Steiermark: Grashange ander Stephaniehohe auf der Turkensekanze bai Wien, 46° 29′ N 14° 34′ E, 30 May 1898, *Handel-Mazzetti s.n.* (WU); Bei Pölshof nahe von Pöls auf trockenem Hang und an Felsen, 47° 13′ N 14° 36′ E, 24 Jun 1964, *Melzer s.n.* (JE, U); Kärnten, nahe der steirischen Grenze südöstlich des Neumarkter Sattels nordwestlich Althaus bei Mühlen aud dem Steilhang der Müllheiten, 47° 6′ N 14° 21′ E, 18 Jun 1969, *Melzer s.n.* (W); Schanze 2. Alte Schanzen, 47° 31′ N 14° 0′ E, 5 Jun 2002, *Mrkvicka 13645* (W); Geisberg bei Rodaun, 46° 58′ N 15° 42′ E, Apr 1904, *Witasek s.n.* (WU). AZERBAIJAN. Kalbajar: Khurdistan, Istisu inf., 39° 56′ N 45° 57′ E, 30 Jul 1934 (S). BOSNIA AND HERZEGOVINA. Srpska Republika: Hercegovina, montis Bjelašica pl., 45° 52′ N 18° 1′ E, 19 Aug 1889, *Murbeck s.n.* (LD); Velez planina, 43° 20′ N 18° 0′ E, 30 Jul, *Sagorski s.n.* (JE). BULGARIA. Blagoevgrad: M. Rilla, pr. lac Sedemjezeru, 42° 8′ N 23° 33′ E, 11 Aug 1939, *Lindberg s.n.* (H). CHINA. Xinjiang: Mongolian Altai, to the west of the village Kok-Togai, riverhead of Cherny Irtysh River, 47° 25′ N 89° 34′ E, 6 Jun 1959, *Botanist of the expedition group 10381* (LE)**;** Mongolian Altai. 20 km to the NW of Shara-Sume (on the river Kran), 48° 34′ N 87° 30′ E, 7 Jul 1959, *Junatov & Yuan' I-fan 1104.1135* (LE). CROATIA. Istarska Županija: Auf felsen b. Vranja, 45° 19′ N 14° 8′ E, 8 Jun 1886, *Ničić s.n.* (WU). CZECH REPUBLIC. Jihomoravský Kraj: Mahren vid Pausram, 48° 56′ N 16° 37′ E, 1 Jul 1936, *Anderberg s.n.* (UPS); Moravia australis: prope pagum Bořetice, 48° 55′ N 16° 51′ E, 24 May 1972, *Dvořak s.n.* (H); Vyškov: in declivibus stepposis collis Větrníky supra pagum Lysovice, 49° 13′ N 16° 58′ E, 17 Jun 1960, *bad handwriting* (M); Galgenberg bei Nikolsburg, 48° 48′ N 16° 38′ E, 22 May 1913, *Korb s.n.* (W); Göding, bei Rohatetz, 48° 52′ N 17° 11′ E, Jun 1936, *Laus s.n.* (JE, LE, W); Weinberg bei Zaisa (Hardegg), 48° 53′ N 15° 52′ E, 12 Jun 1884, *Oborny s.n.* (W); Brnoad, m. Hády versus Velká Klajdovka, 49° 12′ N 16° 42′ E, 10 Jun 1932, *Šestka 765* (C, S, UPS, WU). Liberecký

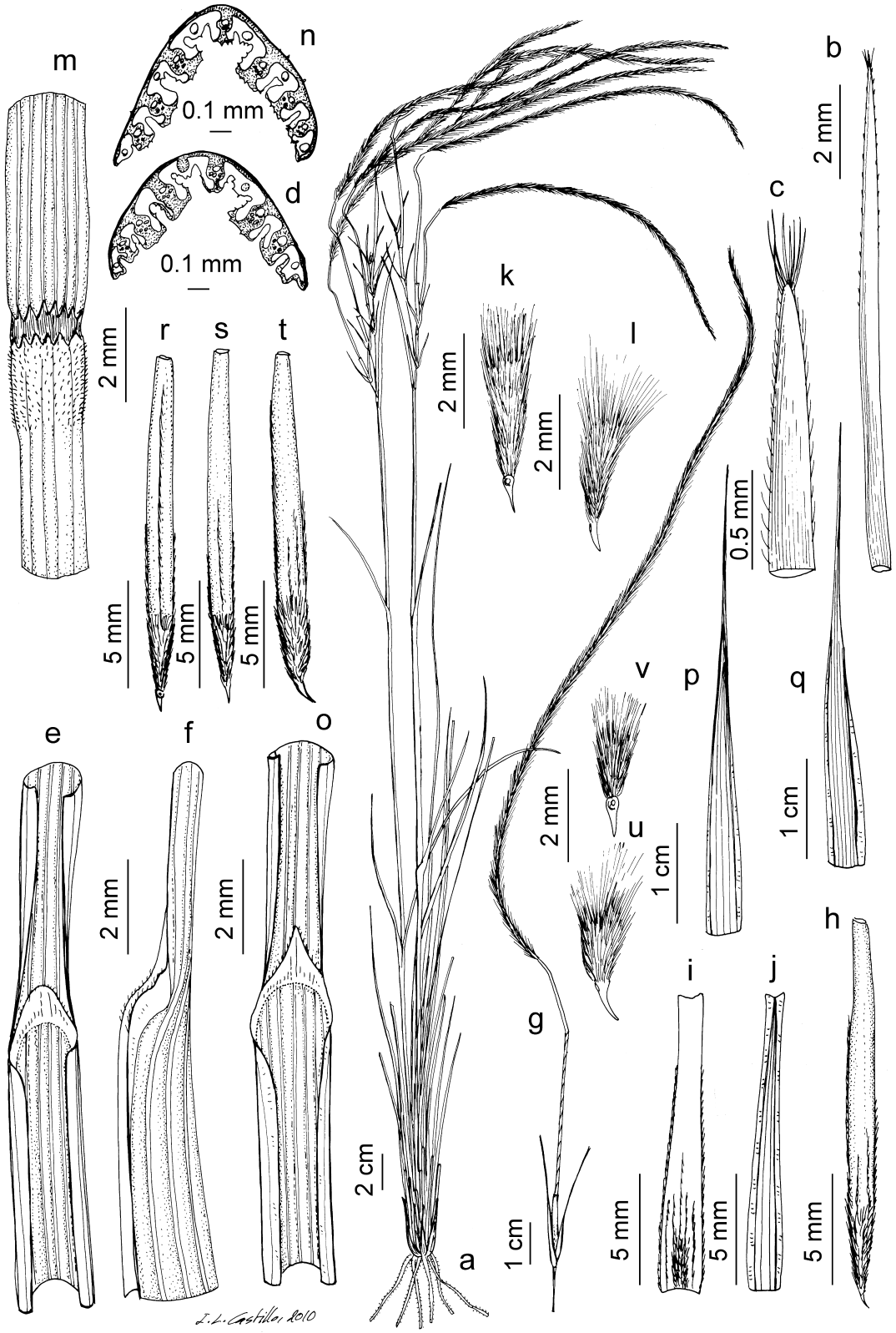


FIG.9. *Stipa pennata* subsp. *sabulosa*. a. Habit. b. Basal leaf apex. c. Detail of the basal leaf apex. d. Transversal section of leaf-blade. e-f. Basal leaf ligule. g. Spikelet. h. Anthecium. i. Lemma. j. Palea. k. Callus, ventral view. l. Callus, lateral view. *Stipa pennata* subsp. *pennata*. m. Culm node. n. Transversal section of leaf-blade. o. Basal leaf ligule. p. Upper glume. q. Lower glume. r. Anthecium, ventral view. s. Anthecium, dorsal view. t. Anthecium, lateral view. u. Callus, lateral view. v. Callus, ventral view. [based on: a-l *Hadinec 2* Jun 1990 (G 00080513); m-v. *Berger 19938* (MA 692669).

Kraj: Nachst Cervene Kolo bei Mt. Boleslav, 51° 0´ N 15° 2´ E, 9 May 1897, *Podpěra s.n.* (H, JE, WU)**;**. Prague: Ungebung Prag, Radolm, 50° 5´ N 14° 28´ E, 13 May 1927, *Asplund s.n.* (S); Praga, 50° 5´ N 14° 28´ E, May 1899, *Podpera s.n* (JE). Středočeský Kraj: Liptschitz, vid Moldan, 50° 40´ N 13° 39´ E, 11 May 30, *Cedercreutz s.n.* (H); Südbohmen auf Felsen in der Hähe von Poskala bei Přibram, 49° 42´ N 14° 1´ E, *Klásková s.n.* (LD); Flora Bohemia. pr. Belá p.-B., 50° 30´ N 14° 48´ E, Jun 1899, *Podpěra s.n.* (JE, W, WU); Karlstein, 49° 56´ N 14° 11´ E, May 1885, *Schiffner s.n.* (C); Pagi Zalov u Msenne, 50° 10´ N 14° 23´ E, 18 May 1926, *Vasak s.n.* (BR). Ústecký kraj: Deblik, 50° 35´ N 14° 3´ E, Jun 1912, *Missbach, s.n.* (S); Langenberg pr. Bečov, 50° 27´ N 13° 43´ E, Jun 1898, *Podpěra s.n.* (GH, S). Zlínský Kraj: Hádyberg bei Brüm, 49° 6´ N 18° 2´ E, May 1899, *Spitsnes s.n.* (JE). FRANCE. Alsace: Colmar (Ht Rhin), 48° 5´ N 7° 22´ E, 3 Jul 1861, *Duval-Jouve s.n.* (G). Languedoc-Roussillon: Vallon de Lozere, 44° 30´ N 3° 30´ E, 22 Aug 1932, *Beauvard s.n.* (G). Provence-Alpes-Côte d´Azur: Lautaret, 45° 2´ N 6° 24´ E, 24 Jul 1934, *Beauvard s.n.* (G); Itatns Alpes route Lantanet-Briaçon, 44° 54´ N 6° 37´ E, 19 Jun 1960, *Charpin s.n.* (G); Beses Alpes vallen du Crachet prés col Vars, 44° 32´ N 6° 42´ E, 9 Jul 1967, *Charpin s.n.* (G); Vallouise, Dauphine (Franhigh), 44° 51´ N 6° 28´ E, 2 Jul 1975, *Schahel s.n.* (L); Gondes, Vaucluse, 43° 54´ N 5° 12´ E, 21 May 1949, *Vautier s.n.* (G). Rhône-Alpes: Savoie, tussen Bonneval en l´Elcot langs de rechter oever van de Arc. Puinhelling, 45° 30´ N 6° 25´ E, 17 Jul 1960, *Stud. Biol. Rheno-Trai. in itinera s.n.* (U). GEORGIA. Tfilis: Near the station Sakachavo, 41° 43´ N 43° 28´ E, 23 Jun 1918, *Kozlovskiy 1347* (H, LE, U). GERMANY. Bayern: Untere Hochebene, um die Kiesgruben westlich von Sammern, 48° 46´ N 12° 58´ E, 11 Jun 1950, *Freiberg s.n.* (M); Oberpflaz. Osthang des Naabtales nordwestlich von Etterzhausen, 10 km westnordestlich von Regensburg; trockener Waldrand gegnüber Penk, 49° 1´ N 11° 58´ E, 18 May 1959, *Roessler 2465* (M); Unterfranken, Unterfr. Muschelkalkgebiet: Hohfeld plerbe nidóok. Thingersheim, 49° 14´ N 11° 43´ E, 13 Jun 1986, *Schuhwerk 86/140* (M); Kreuznach, 49° 50´ N 7° 52´ E, Jul 1877, *Geisenheyner s.n.* (JE); Legenfeld bei krems a./d. Donan Spiesberg, 50° 7´ N 11° 12´ E, Jun 1935, *Handel-Mazzetti s.n.* (WU); Flora Badensis Badberg bei Vbgtsberg, 48° 15´ N 12° 5´ E, 1865, *Lenz s.n.* (G), Baden-Württemberg: Mitterndorf gegen Moosbrunn nächst Wien auf trockenen Wiesenhäufig, 49° 25´ N 8° 55´ E, 1 Jun 1902, *Handel-Mazzett s.n.* (WU). Brandenburg: Mittenwalde: Gr Machnower Weinberge, 52° 17´ N 13° 27´ E, 18 Jun 1882, *Gross s.n.* (S); Mark Brandenburg, Reitrveiner Borge, 52° 24´ N 12° 30´ E, 14 Jun 1879, *Jachan 9* (JE). Rheinland-Pfalz: Felsen dicht oberhalb Bahnhof Hatzenport rechts der Chaussee nach Münstermaifeld, 50° 15´ N 7° 22´ E, 11 Jun 1950, *Freiberg 105/6* (M); Norfitforb bei Fischbach Birkenfeld, 49° 44´ N 7° 24´ E, 22 May 1897, *Ljirft s.n.* (W); H. Thieme. Mainz, 50° 0´ N 8° 16´ E, 1843, *Schleiden s.n.* (JE); In Fulfun bei Oberstein, 49° 42´ N 7° 19´ E, 20 May 1897, *Hirth s.n.* (G); Nahetal, Bad Münster am Stein, Rotenfels, 49° 49´ N 7° 51´ E, 31 May 1987, *Krendl s.n.* (W); Environs de Bingen, 49° 58´ N 7° 54´ E, Jul 1879, *Muller s.n.* (BR). Sachsen-Anhalt: Abhänge zum Selketal (Harz), 51° 45´ N 10° 30´ E, 10 Jun 1947, *Aach s.n.* (W); Steinklebe bei Wendelstein, 51° 17´ N 11° 28´ E, Jun 1878, *Anhel s.n.* (JE); Mittelgebirge. Böhm. Leipa, 51° 50´ N 12° 36´ E, 26 Jun 95, *Gross s.n.* (UPS); Hohe Leeden bei Domburg, 51° 52´ N 11° 19´ E, 15 Jun 1899, *Haussknecht s.n.* (JE). Thüringen: Kyffhauser, Heinthaleben, 51° 23´ N 11° 5´ E, 22 May 1953, *Branco s.n.* (JE); Fl. de Nassau Sternberg bei Bornhofen, 51° 27´ N 10° 47´ E, 25 May 1880, *Einsander s.n.* (JE); Keruberg bei Jena, 50° 55´ N 11° 36´ E, May 1953, *Groll s.n.* (JE); Mittelberg bei Auleben, 51° 21´ N 10° 10´ E, 1827, *John s.n.* (JE). GREECE. West Macedonia: Vernon Oros, vom Vitsi nach Drosopigi, 40° 39´ N 21° 22´ E, 10 Jul 1978, *Krendl s.n.* (W). HUNGARY. Békés: Jánosháza (Baes-Bodrag), 46° 29´ N 21° 15´ E, 14 Jun 1910, *Prodán s.n.* (S). Budapest: In Comitat Pest in Ungarn am Hármashatárhegy bei Ofen, 47° 30´ N 19° 2´ E, 6 Jun 1900, *Degen & Flatt 82* (BR, GH, H, JE, L, MA, W); Kasposztasmegeger bei Rakospalota, 47° 34´ N 19° 8´ E, 23 May 1933, *Korb s.n.* (W); Monor, in Steppenwäldern bei Csévharaszt, 47° 18´ N 19° 26´ E, 16 jun 1975, *Lippold s.n.* (JE). Hajdú-Bihar: Hortobágy, 47° 35´ N 21° 10´ E, Jul 1936, *Timmermans s.n.* (L). Pest: Budaöns, Kakukk hepy, 47° 36´ N 18° 56´ E, 29 May 1963, *Bisse s.n.* (JE); Inter Monor et Pilis, 47° 41´ N 18° 53´ E, 31 May 1888, *Borbás s.n.* (JE); In monte "Nagy Koppán". In montibus "Börzsöny", 47° 54´ N 18° 51´ E, 14 May 1939, *Walger s.n.* (S, UPS); Farmos, 47° 22´ N 19° 51´ E, 6 Jun 1937, *Branco s.n.* (JE); Budaörs. Csiki hegyek, 47° 27´ N 18° 58´ E, 26 May 1963, *Schneide s.n.* (JE); Veszprém: Bakony, vallis Aszóvotgy infra Alsópere versus Hajméskér, 47° 15´ N 17° 50´ E, 29 May 1928, *Jávorka s.n.* (S)**;** 100 m boven Balatonfüred op. Z.O.-helling, 46° 57´ N 17° 53´ E, 19 May 1972, *Kramer 4962* (U). Zala: Keszthelyi-hegi. N Gyenesdiás

am Kömell, 46° 46´ N 17° 17´ E, 11 May 1975, *Krendl s.n.* (W). Virös-Benény Vesprimii, May 1900, *Borbás s.n.* (JE). IRAN. Āẕarbāyjān-e Sharqī: Montes Qareh Dagh, prope Aliabad 20 km SW Kaleybar, 38° 52´ N 47° 2´ E, 20 Jul 1971, *Lamonf & Thermé 44360* (W). ITALY. Apulia: Promontorio del Gargano, 41° 50´ N 16° 0´ E, 6 Jun 1990, *Licht 941 b* (B). Emilia-Romagna: Mte Colombo Val Gesso (FI) 43° 55´ N 12° 33´ E, 18 Jul 1961, *Bono s.n.* (FI). Friul-Venecia Julia: Trieste, Monte Spacerto, 45° 40´ N 13° 46´ E, Jun 1869, *Marchesetti s.n.* (HBG). Piamonte: Valle Formazza-Riva sinistra del t. Hohsand tra Zum Stock e Grelschbode, 46° 22´ N 8° 26´ E, 29 Aug 1912, *Boggiani s.n.* (BR); Alpe marittime, Argentera, ob der Terme di Valdieri, gegen die Gias Lagarol, 44° 12´ N 7° 16´ E, 6 Jul 1982, *Burri & Krendl s.n.* (W). Valle de Aosta: Prov. Cuneo, Alpi Cozie Ander Straβe von Casteldelfino im Valle Varaita zum Colle di Valante, 44° 35´ N 7° 4´ E, 13 Aug 1980, *Lipper & Merxmüller 17331* (M). Veneto: Oerh San Vigilio, 46° 37´ N 11° 7´ E, 23 Apr 1951, *Aach s.n.* (W). KAZAKHSTAN. Akmola: Atbasar District. Basin of Beleudty river, Dyusenbai river at the middle part, 49° 43´ N 65° 45´ E, 18 Jun 1914, *Krascheninnikov 5345* (S). East Kazakhstan: Ivanovsky range, in the region of Poperechnoe village. The valley of Belaya uba river, 50° 28´ N 83° 48´ E, 25 Jun 1970, *Kotukhov s.n.* (UPS); Altaj merid. Jugum Narymense, prope pag. Katon-karagaj, 49° 10´ N 85° 30´ E, 2 Jul 1930, *Smirnow 28* (H, JE, L, S, W); Saur range, the upper reaches of the Kizil-Kiya river, in the region of Kizil-Kiya winter camp, 47° 4´ N 85° 30´ E, 3 Jul 1991, *Kotukhov s.n.* (B, K, UPS); Altaj merid, ad fl. Sarymssak, prope pag. Katon-karagaj, 49° 10´ N 85° 30´ E, 2 Jul 1930, *Smirnow 4* (H, JE, L, S, W). MACEDONIA. Polog: E-Hänge der Sar Planina oberhalb Tetovo, Kalkfelshänge oberhalbe Popova Sapka, 42° 0´ N 20° 58´ E, 6 Aug 1976, *Podlech 28441* (M). Southeastern Republic Macedonia: Prilep, montis Drenska-planina, 41° 23´ N 22° 13´ E, 12 Jun 1918, *Bornmüller 5192* (JE). Vardar: N Pisoderion, auf der Bela Voda, 41° 38´ N 21° 44´ E, 5 Jul 1978, *Krendl s.n.* (W); Babuna Fl. Mukos-Dab, 41° 40´ N 21° 48´ E, May 1969, *Leute 50* (W); Baba Planina: Nordseite des Pelister bei Bitola, 41° 1´ N 21° 20´ E, 1 Jul 1968, *Roessler 6363* (M). MONGOLIA. Zapadna Mongolia, Gora May Kapsagai kamo, 6 Jun 1914, *Sishkin s.n.* (NY). POLAND. Kujawsko-Pomorski: Torun-Bielany, 45º 53° 2´ N 18° 36´ E, 31 May 1975, *Gugnacka-Fiedor 195* (H, L, UPS). ROMANIA. Arad: Inter Mócs and Szombathely, Transilvania centralis, 46° 8´ N 21° 31´ E, 1 Jun 1869, *Janka s.n.* (PR, W, WU). Braşov: Distr. Braşov, 45° 38´ N 25° 35´ E, Jun 1965, *Morariu s.n.* (LD). Caras Severin: Dorfes Kursovecz im Comitat Krassó-Scöreny im Banat, 45° 30´ N 21° 45´ E, 25 Jun 1902, *Lajos 312* (C, GH, H, L, MA, W). Prahova: Tohani, distr. Prahoca-Romania, 45° 4´ N 26° 26´ E, 1 Jun 1969, *Negrean s.n.* (M, S). Tulcea: Babadagh, 44° 54´ N 28° 43´ E, 11 Jun 1973 (LD). RUSSIA. Astrakhanskaya Oblast: B. Bagdo, 46° 13´ N 47° 11´ E, 28 May 1925, *Iljin & Grigorjev 137* (S). Bashkortostan: Bashkir Republic (former Ufa Province). Belebeevskiy District. The island on the Kandry-Kul' lake, 54° 30´ N 54° 4´ E, 21 Jun 1926, *Fedchenko, B.F. et al 201* (LE); Zalair District. 5 km SE from Mrakova village, 53° 47´ N 56° 11´ E, 3 Jul 1928, *Knorring 178* (LE). Buryatiya: Mukhor-Shibir' village, Ulan-tuya village, 51° 14´ N 107° 35´ E, 11 Jul 1965, *Peshkova & Tarasova 2043* (LE); Ulan-Ude District, Nadeino village, Vyosaya mountain, 55° 20´ N 39° 45´ E, 14 Jul 1967, *Reschikov s.n.* (LE). Bryanskaya: Markovsk ad fluv. Sudost. ca 1 km N a pago, 52° 24´ N 33° 15´ E, 6-7 Jul 1979, *Skvortsov s.n.* (M). Chelyabinskaya Oblast': The Southern Ural, the vicinity of Miass town (former Miass plant). Ilmen Reserve, top of Savel'kul' mountain, 55° 16´ N 61° 53´ E, 16 Jun 1937, *Dervtz s.n.* (LE). Irkutskaya: Balagansk District, on islands of Angara river, Ubinskoye Lake, 52° 17´ N 104° 14´ E, 14 Jul 1909, *Ganeshin 374* (LE); Balagansk District, Bazheevskoye village, 52° 58´ N 102° 38´ E, 16 Jun 1906, *Maljtsev 376* (C, GH, H, JE, L, LE, NY, S, W); Irkutskaia guberniia, 8 Jun 1907, *Maljtsev s.n.* (M). Kabardino-Balkariya: Caucasus centralis: distr. Tyrnyauz, montis Elbrus, in vicinitae glaciae Shelda, 43° 15´ N 42° 38´ E, 29 Jul 1981, *Vašak s.n.* (W). Krasnodarskiy: Baraba. Between villages Taryshkina and Kochetovskiy, 44° 15´ N 39° 23´ E, 10 Jun 1912, *Krylov s.n.* (NY). Krasnoyarsky: Minusinsk Basin, Tigritskoye village, 53° 35´ N 92° 24´ E, 23 Jun 1959, *Golubeva et al. s.n.* (LE); Minusinsk Basin. Vicinity of village Tigritskoye, 53° 35´ N 92° 24´ E, 20 Jun 1959, *Golubeva et al s.n.* (LE); Yenisei Province, Kanskiy district. Steep slope to river Rybnaya near village V. Rybinskoye, 55° 46´ N 94° 46´ E, 3 Jun 1911, *Kuznetsov s.n.* (LE); Yenisei Province, Achinsk district, Podgornoye village, valley of Chulym, 56° 4´ N 90° 20´ E, 8 Jul 1912, *Kucherovskaya s.n.* (LE); Minusinsk District, Between mountain Izyk Yerbinskiy and river Bei-Buluk, 53° 58´ N 90° 18´ E, 2 Aug 1910, *Smirnow 54* (S). Kurganskaia:

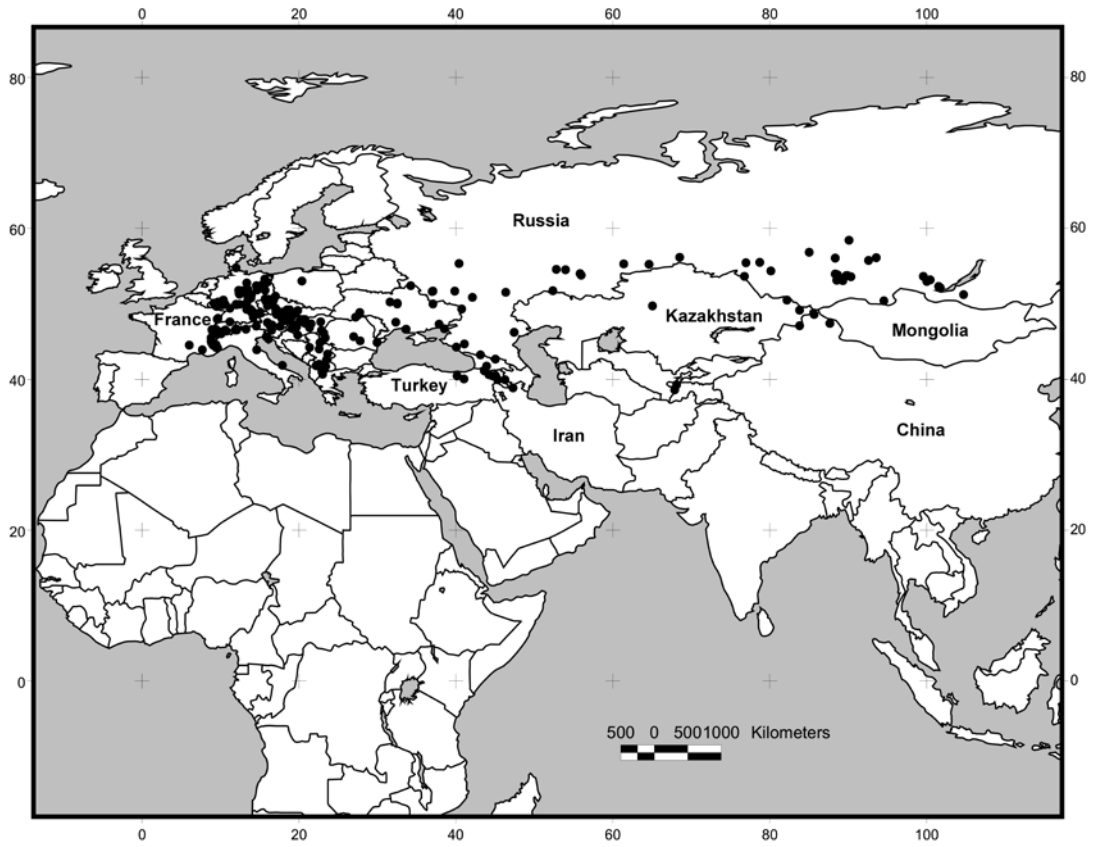


FIG. 10. Distribution map of *S. pennata* subsp. *pennata* (●).

Kurgan District, Zvenigolovskiy District, Shemerov Village on river Alabuga, 55° 14′ N 65° 18′ E, 19 Jul 1928, *Ivanova & Tonshina 836* (LE). Kurskaya: Streletskiy District, Central-Chernozem State Reserve, Streletskaya steppe, 51° 36′ N 36° 8′ E, 29 Jun 1965, *Novičkova s.n.* (H). Novosibirskaya: Chanovskiy District, close to railway station Karachi, 53° 37′ N 78° 5′ E, 28 Jun 1956, *Vagina & Kovachevich s.n.* (JE); Ordynsky District, Noviy Sharap village, 54° 20′ N 81° 40′ E, 19 Jun 1957, *Kulshnova & Buturlina s.n.* (S). Orenburg: Watershed of the rivers M. Churan and Tok, "N of Staroe Gumerovo village, 51° 45′ N 52° 21′ E, 7 Jun 1930, *Suhova 18* (LE). Samara: Bugulma district, between fortresses Cheremshanskaya and Sheshminskaya (in about 2 km from each other), 54° 33′ N 52° 48′ E, 23 May 1889, *Korshinsky s.n.* (C). Saratow: Sarepta, 51° 32′ N 46° 0′ E, *Becker s.n.* (BR, JE, S, UPS, WU). Tomsk: Kainski district, Krasnovskij, 56° 51′ N 86° 47′ E, 1912, *Kronotov s.n.* (LD); Kainsk district, prope pag. Pogorjelskaja, 55° 27′ N 78° 18′ E, 25 Jun 1930, *Poddjakova s.n.* (NY); Kainsk district. Ubinskoye Lake, 55° 30′ N 80° 10′ E, 8 Jun 1912, *Klopotov s.n.* (S). Tyumenskaya: Tobolsk Province. Ishimskiy District, NE of village Afonino, on Kuchumova gora, 56° 10′ N 69° 25′ E, 2 Jul 1895, *Gordyagin 1260* (LE). Tuvinsky: Usinsky Region and the adjacent part of the Uryanskiye steppes, 58° 26′ N 92° 10′ E, 1907, *Shulga s.n.* (LE). Voronezh: Circa Voronezh, 51° 40′ N 39° 12′ E, *Grüner s.n.* (C). SERBIA. Bajna Basta: Wess-Velez, 44° 13′ N 19° 39′ E, 10 Jul 11, *Schneider s.n.* (W). Bela Crvka: Banat, Deliblatska peščara inter Devojački bunari et Korn, 44° 54′ N 21° 5′ E, 29 Apr 1968, *Mayer s.n.* (M). Pančevo: Deliblát. Kincstári homokpuszta, 44° 49′ N 21° 2′ E, May 1909, *Ullepitsch s.n.* (U). Pirot: Sićevo, 43° 20′ N 22° 5′ E, 10 Jun 1932, *Ilić s.n.* (WU). Šumadija: Kragujevac (Bozatsch), 44° 1′ N 20° 55′ E, May 94, *Dimitrijin s.n.* (WU). Vranje: Monte Pljačkavica, 42° 35′ N 21° 54′ E, 11 Jul 1896, *Adamovic s.n.* (W). SLOVAKIA. Bratislavský: Pressburg, 48° 9′ N 17° 7′ E, May 1868, *Schneller s.n.* (BR, UPS); Nitriansky: Čachtice bei Nové Mesto nad Váhom, 48° 43′ N 17° 47′ E, 21 May 193, *Gailing s.n.* (JE); Sandflächen bei Čenkow, unweit Štúrow an der Donau , 47° 56′ N 18° 31′ E, 14 Jun 1962, *Schneider s.n.* (JE). SWITZERLAND. Graubünden: Between Sur et Rona (grisons), 46° 33′ N 9° 37′ E, 13 Jul 1975, *Berghenv s.n.* (BR); Eggerberg, 46° 19′ N 7° 52′ E, 4 Jun 1986, *Theurillata 4010* (BR, C, H, L, M, MA). Thurgau: Pfin (Schweiz, Kanton Wallis) Pfinwald südwestlich Milliere, 47° 35′ N 8° 57′ E,

21 May 1965, *Berger 2957* (BR, H, MA). Valais: Zmutt (bij Zermatt), 46° 1′ N 7° 45′ E, 23 Jul 1934, *Boom 8695* (L); Branson (Schweiz, Kanton Wallis) bei Les Follatères, 46° 35′ N 6° 30′ E, 18 May 1957, *Berger 16735* (BR, H, MA); Zermatt, 46° 1′ N 7° 45′ E, Jul 1955, *Duvigneaud s.n.* (BR); Hügel in Pfynwald bai Siders, 46° 32′ N 8° 18′ E, 8 May 1934, *Koch s.n.* (LD, MA, NY, S). TAJIKISTAN. Sughd: Central part of Mountain Zeravshan. Basin of River Pasrut, left bank of river Izmat, 39° 15′ N 69° 0′ E, 18 Jul 1948, *Korotkova 443* (M); Pamir, Hissarski khrebet, 20 km situ septentrionali ab appido Dushnabe, in valle flumiinis Varzob, 38° 35′ N 68° 46′ E, 23 May 1974, *Vasak s.n.* (M). TURKEY. Erzurum: Askale-Bayburt 1 km s Kop Gecidi, 40° 3′ N 40° 26′ E, 14 Jul 1988, *Nydegger 43755* (G); Gümüshane: Armenia turcica Szanschak Gümüschkhane. Karagoelldagh, 40° 27′ N 39° 29′ E, 31 Jul 1894, *Hackel 7383* (BR, G, JE, W). UKRAINE. Chernivets'ka Oblast: Kleine Karpathen: Auf dem Berge Kamena bei Blasenstein, 48° 14′ N 25° 50′ E, 23 May 1926, *Ronniger s.n.* (H). Donetsk: Stalin region, Volodarsky District, village Nazarovka, reserve Kamennye Mogily 47° 18′ N 37° 4′ E, 1 Jun 1954, *Kuznetsova s.n.* (LE). Kharkivs'ka Oblast: Circa Charcovia, 50° 0′ N 31° 27′ E, 31 May 1854, *Czerniaëw s.n.* (MEL). Khersons'ka Oblast: Cherson, 46° 38′ N 32° 36′ E, Jun 1866, *Lindemann s.n.* (BR). Kyyivs'ka Oblast: Kiev, 50° 15′ N 30° 30′ E, 25 May 1925, *Pisopliczka s.n.* (S). Luhansk: Voroshilovgrad Region, Melovskoy District, reserve Streletskaya steppe, 49° 18′ N 40° 5′ E, 26 May 1956, *Sarycheva s.n.* (LE). Mikolayiv. Semenovkaon Bug village, 47° 32′ N 31° 16′ E, 9 May 1909, *Pachoskii s.n.* (LE).

b. subsp. SABULOSA (Pacz.) Tzvelev, Novosti Sist. Vyssh. Rast. 10: 80. 1973; *S. pennata* f. *sabulosa* Pacz., Fl. Chers. 1: 112. 1914; *S. joannis* subsp. *sabulosa* (Pacz.) Lavr., Fl. URSS 2: 123. 1940; *Stipa borysthenica* Klok. ex Prokud. in E. Wulff, Fl. Kryma 1(4): 25. 1951; *S. sabulosa* (Pacz.) Sljussarenko, Trudy Nauchno-Issled. Inst. Biol. 37: 26. 1963. nom. illeg.—TYPE: UKRAINE. Kherson province, Alexandrovoskii post, along Tyasmin, 18 Jul 1911, *Pachoskii s.n.* (lectotype: LE!, designated by Tzvelev, 1976)

Stipa anomala P.A. Smirn., Delect. Sem. Horti. Bot. Univ. Mosq. 15. 1930; *S. pennata* var. *anomala* (P.A. Smirn.) Tzvelev, Novosti Sist. Vyssh. Rast. 11: 18. 1974.—TYPE: KAZAKHSTAN. Uralsk District, Teplov Region between the villages of Faduleev and Novenk, 16 Jun 1929, *Rubtsov s.n.* (holotype: LE!).

Stipa joannis subsp. *germanica* Endtm., Wiss. Z. Ernst-Moritz-Arndt-Univ. Greifswald, Math.-Naturwiss. Reihe 11: 148. 1976; *S. germanica* (Endtm.) Klokov, Novosti Sist. Vyssh. Nizsh. Rast. 1975: 67. 1976; *S. sabulosa* subsp. *germanica* (Endtm.) Martinovský & Rauschert, Preslia 48: 187. 1976; *S. borysthenica* subsp. *germanica* (Endtm.) Martinovský & Rauschert, Feddes Repert. 88: 320. 1977; *S. borysthenica* subsp. *germanica* (Endtm.) Dengler, Gleditschia 28: 20. 2000, comb. superfl.—TYPE: GERMANY. Geesower bei Gartz (oder) Geesower Hügel, Hügel 3, 11 Jun 1960, *Endtmann s.n.* (holotype: GFW; isotype: JE!)

Stipa joannis var. *marchica* Endtm., Wiss. Z. Ernst-Moritz-Arndt-Univ. Greifswald, Math.-Naturwiss. Reihe 11: 148. 1976; *S. borysthenica* var. *marchica* (Endtm.) Rauschert, Mitt. Florist. Kart. 4: 11. 1978.—TYPE: GERMANY. Naturschutzgebiet "Geesower Hügel" zwischen Gartz/Oder und Geeson /Kr. Angermünde, 18 Jun 1960, *Endtmann s.n* (holotype: GFW; isotype: JE!)

Herbs 40-75 cm high. Basal leaves 15-55 cm long. Leaf-blades abaxial surface glabrous or minutely scabrous, adaxial surface scabrous, leaf-blades apex glabrous or with an apical tassel of hairs almost at young leaves. Culms leaf-sheaths, papillose or scabrous. Glumes (3.5)4.5-6(8) cm long. Anthecium (16)16.6-20(21) mm long; lemma (12.2)12.6-16 mm long, with seven rows of hairs, the dorsal and subdorsal row slightly fused at the base and the remainder rows distinct, the ventral one ending (0.5)3-5(6) mm long below the top, the dorsal row ending (7.2)7.3-9(10) mm below the top and longer than the subdorsal ones. Callus (3.8)3.9-5 mm long (callus/lemma= (0.26)0.27-0.33(0.35)), villous, scar elliptic, straight, peripheral ring (0.67)0.77-0.96(1) mm long, (0.2)0.21-0.26(0.28) mm wide (ratio width/length= (0.23)0.24-0.32(0.36)). Awn (25)29-35(36) cm long. (Fig. 9 a-l)

Chromosome Number—unknown

Habitat and Distribution—Grows on sandy soils of slopes, steppes, riversides and forest glades, from seacoasts up to lower mountain belts, 0-2000 m. Ranges from East and Central Europe to South-East Russia, also occuring in Kazakhstan (Aral Caspian, Balkhash area), and in South and central Siberia. Scarcely found in western Mongolia. (Fig. 11)

Phenology—Flowering specimens have been collected in May, June and July.

Representative Specimens Examined—AUSTRIA. Niederosterreich: Marchfeld, Weikendorfer Remise: Düne 0,4 km NE kt 152/Brunnfeld (7666/4), 48° 33´ N 16° 79´ E, 25 may 1986, *Strudl 145* (W); Weinviertel, Falkenstein: 0.5 km NNE de Ruine, 48° 43´ N 16° 46´ E, 20 May 1985, *Pokorny & Strudl s.n.* (W); Weinvertel, Gollitsch bei Retz, SW Hang oberhalb des Steinbruch, 48° 78´ N 15° 96´ E, 31 May 1982, *Pokorny & Strudl s.n.* (W). BULGARIA. Varna: 15 km W of Varna, NW of Povelianovo, Pobiti camani place, 43° 13´ N 27° 42´ E, 2 Jun 1999, *Raus & Pina Gata 35-1-13* (W); N of Nessebar, 42° 37´ N 27° 43´ E, 27 May 1999, *Raus & Pina Gata 24-1-4* (W). CZECH REPUBLIC. Jihomoravský Kraj: Göding, pr. Rohatetz, 48° 52´ N 17° 11´ E, Jun 1935, *Laus s.n.* (H); Hodonín district, inter opp. Bzenecet Rohatec, 48° 55´ N 17° 16´ E, 2 Jun 1990, *Hadinec s.n.* (G). GERMANY. Bayern: Niederbayern: Felsen der Weltenburger Enge gegnüber dem Kloster Weltenburg, Landkreis Kehlheim, 48° 54´ N 11° 50´ E, 2 Jun 1962, *Podlech 8209* (M). Berlin: Berlin, 52° 19´ N 13° 33´ E, (MEL). Brandenburg: Potsdam, 52° 24´ N 13° 2´ E, *Oenicke s.n.* (H, S); Braddburgo. N-Rand des "Höllengraund" arm W-Rand des, 52° 27´ N 13° 58´ E, 19 Jun 1964, *Endtmann s.n.* (JE); Geesower Hügel (nr 4; SW-Hang) S Geeson, Kr Angermünde, 53° 2´ N 14° 0´ E, 20 Jun 1962, *Endtmann s.n.* (JE); Gresower Hügel, nr 4 seeson / Kr. Angerm, 53° 15´ N 14° 23´ E, 15 Jun 1964, *Endtmann s.n.* (JE); 0,5 km NNW vornerk Bergthal von Altranfl, Kr. Freienwalde 10, 52° 45´ N 14° 4´ E, 18 Jul 1962, *Endtmann s.n.* (JE); Rhinow, am Litchcberg, 52° 45´ N 12° 20´ E, Jul 1898, *Pralrow s.n.* (M); Missenval de Co Machnower Weinberge, 52° 17´ N 13° 27´ E, 28 Jul 1881, *Scheppig s.n.* (M). HUNGARY. Bács-Kiskun: S Teil des Alföld, Kiskunsag, ca. 6.5 km W Fülöphaza, Szappen-Szek, 46° 35´ N 19° 15´ E, 8 May 2005, *Walter 8175* (W); Kecskemét area, Fülphaza (20 km Wof Kecskemét), 44° 47´ N 19° 5´ E, 26 May 1987, *Bergqvist et al. 5* (S). Budapest: Budapest, Csepel, Insel, 47° 25´ N 19° 5´ E, 19 May 1929, *Ronniger s.n.* (W). Pest: Montis Kis Szenús supra Pilis-Szentivan, 47° 37´ N 18° 54´ E, 21 May 1916, *Degen s.n.* (S); Pest Ongeveer 30 km oostelijk van Solt, nabij Fülöpháza, district B´cs-Kiskun, 44° 47´ N 19° 5´ E, 30 May 1970, *Bodemk. exc.- Th. J. Visser 141* (U). IRAN. Āẕarbāyjān-e Gharbī: Berdesin valley, 38° 29´ N 45° 0´ E, 20 May 1929, *Cowan & Darlington s.n.* (K). KAZAKHSTAN. Akmola: Western Karabutak, 51° 47´ N 73° 21´ E, 3 Jul 1971, *Ikonnikov & Litvinova 6747* (LE); Kurgalyino District, village Arykty, 50° 38´ N 70° 33´ E, 29 May 1973, *Lovelius s.n.* (LE). Aktobe: Chelkar District, slope of Tyubel against the place of its falling to Ters-Butak, 58° 2´ N 48° 18´ E, 31 May 1927, *Spiridinow 294* (NY)**;** Turgai Region, Aktyubinsk, 52° 55´ N 62° 22´ E, 2 Jun 1904, *Yanishevsky s.n.* (K). East Kazakhstan: Semipalatinsk Province, Krasnooktyabr'skaya parish, right bank

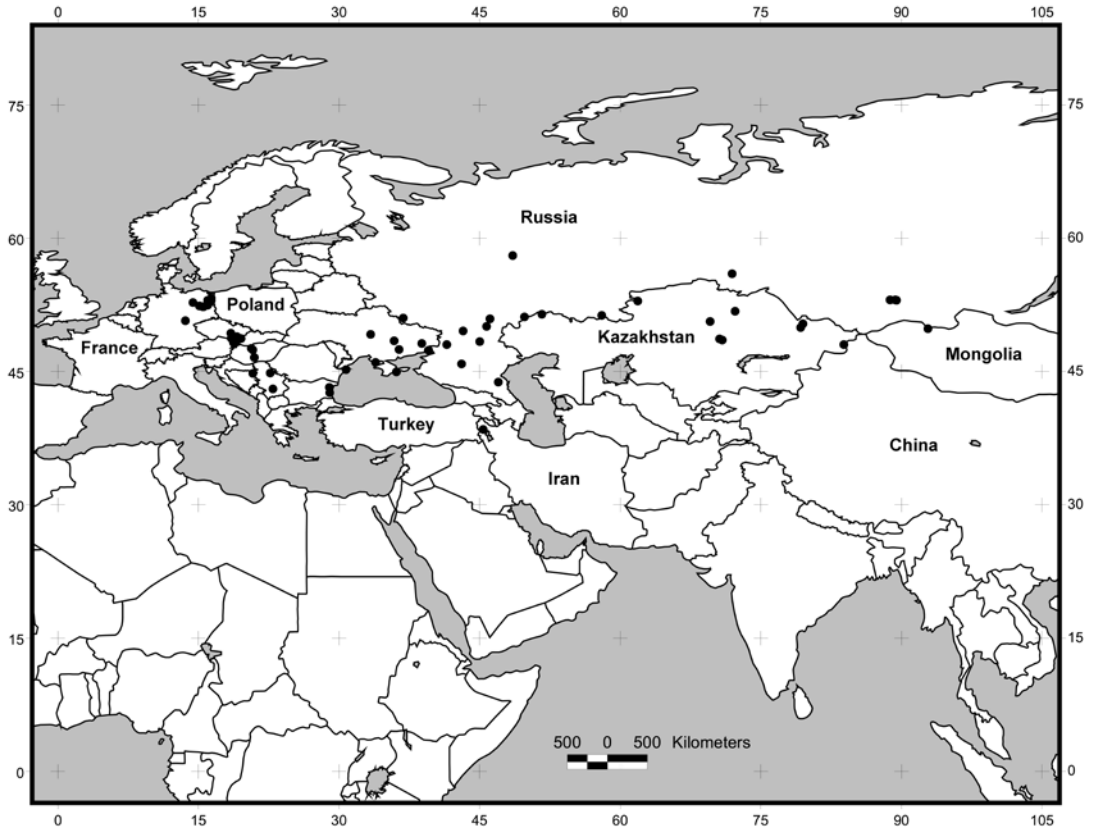


FIG. 11. Distribution map of *S. pennata* subsp. *sabulosa* (●).

of river Chara, 49° 57′ N 80° 44′ E, 6 Jun 1928, *Enden 102* (NY); Novoshul'binskiy District. Vicinity of village Bazhenovka, Irtysh floodplain, 50° 23′ N 80° 59′ E, 10 Jun 1973, *Prokofiev & Agafanov s.n.* (C); Valley of River Cherny Irtysh (Black Irtysh) near Alkabek on mountain "Chudesa", 48° 1′ N 85° 34′ E, 23 May 1961, *Grudzinskaya* (LE). Karagandy: Upper reaches of River Sary-su, valley of Dzhaksy-sary-su river. N Zhana-Arka, 48° 41′ N 71° 37′ E, 4 Jun 1937, *Pazij 19* (LE); Left bank of the river Sary-su, near Dzhezkazgan-Zharyk railway-line, on 179 th km, 48° 34′ N 71° 54′ E, 22 Jun 1958, *Grubov 21* (LE). MONGOLIA. Uvs: The eastern edge of Ubsunur Hollow.,S Altan-els, 70 km to NE of Barun-Turun (Ybsunur Region), 49° 50′ N 95° 5′ E, 5 Jul 1988, *Kamelin et al. 876* (LE). POLAND. Zachodniopomorskie: Nawodna near Chojna/Szczecin Province, 53° 0′ N 14° 24′ E, 30 Jun 1973, *Ceynowa-Gieldon 297* (H); Rudnica Stara. Szczecin Prov., on slope of river Odra valley, Rudnica Stara and the railway station Siekierki, 52° 49′ N 14° 15′ E, 10 Jun 1969, *Ceynowa-Gieldon 296* (H). ROMANIA. Tulcea. 18 km NNW of Sulina at Sfistofca, 45° 12′ N 29° 35′ E, 10 Jun 1987, *Lundqvist 16738* (S). RUSIA. Dagestan: Kizlyar District. Ravine Ary-su, prope Ariu-Su, 43° 50′ N 46° 42′ E, 23 Jun 1926, *Prokofieva 122* (NY). Khakasiya: Minusinsk District, Yenisei River, the vicinity of Oznachennoe village, 53° 5′ N 91° 23′ E, 25 Jun 6 Jul 1926, *Reverdatto s.n.* (S); Minusinsk Basin, Khakassia Autonomous Region, Beisk District, between B. Uty and Ust'-Kendyryk, 53° 4′ N 90° 47′ E, 3 Jul 1959, *Golubeva et al. s.n.* (LE). Kurskaya: Flora Kurskaya, 51° 0′ N 36° 0′ E, 1906, *Kashmenskiy s.n.* (W). Omsk: Sibiria, prope oppid. Omsk, 56° 0′ N 73° 0′ E, Jun 187?, *Weckman s.n.* (H). Oremburg: Guberlinskie Mountains, 5 km above the mouth of Guberli river, 51° 20′ N 58° 21′ E, 18 Jun 1964, *Vinogradova 61* (LE). Rostovskaya: Gow, Charkow, Pokrowskoye, 47° 24′ N 38° 53′ E, 29 May 1854, *Reinhard s.n.* (W); Voroshilovograd Region, Krasnodon District, 8 km S of Krasnodon on the highway to Sverdlovsk, 48° 1′ N 40° 54′ E, 14 May 1971, *Ikonnikov & Litvinova 5099* (LE). Saratov: Ural Region, Chizhi district, from Chizhi II to Ozinki, on the top of Obschiy Syrt, 51° 10′ N 49° 40′ E, 2 Jun 1924, *Larin & Musatowa 218* (NY). Volgograd: Sarpa distr. inter Zaza et Plodovitoie, 48° 22′ N 44° 37′ E, 14 May 1970, *Skvortsov s.n.* (C); Left bank of river Don, Frolov District, between Serafimovich and Archeda, 49° 34′ N 42° 44′ E, 17 Jun 1971, *Ikonnikov et al.6100* (LE). SERBIA. Central Serbia: Banat, ad

Deliblato, 44° 49´ N 21° 2´ E, May 1935, *Soška s.n.* (S); Banat, Deliblatska peščara inter Devojački bunari et Korn, 43° 2´ N 21° 19´ E, 29 Apr 1968, *Mayer s.n.* (H). SLOVAKIA. Trenčiansky kraj: Nové Mesto nad Váhom, pagus Visnové, sub ruina Cachticky, 48° 43´ N 17° 45´ E, 12 May 2002, *Šída 4387* (M). UKRAINE. Chersons´ka Prov: Cherson, ins. Dscharylgacz, Srednij, 46° 2´ N 32° 55´ E, 23 May 1948, *Pobedimova 5102* (C, H, JE, LE, M, W). Dnipropetrovs'ka Oblast: Marinpol district, pag. Czerdakly, supra fl. Kalczik, 48° 27´ N 34° 59´ E, 17 May 1926, *Kleopow s.n.* (S, W). Donetsk: Urochische Sosna, Mayatzkoe lesnichastvo (dendrological park), 48° 10´ N 38° 7´ E, 21 Jul 1973, *Ivashin 1516* (LE). Krym: Sudak district, mountain Syry-Kay (Karadag Range) near village Planerskoe, 44° 57´ N 35° 14´ E, 25 Aug 1961, *Tzvelev 353* (H). Zaporiz'ka Oblast: Distr. Ossypenkiensis, prope opp. Ossypenko, 47° 30´ N 35° 30´ E, 19 May 1930, *Kleopow s.n.* (S).

Notes—The name *S. pennata* was rejected by several authors, who considered it a "*nomen ambiguum*" (Scholz 1968; Fuchs-Eckert 1980; Kerguelen 1983) because it includes several taxa in the species concept. Previosly, Mansfeld (1939) tried to clarify the taxonomic position of *S. pennata*, and cited a Clusius plate, that belongs to what has been frequently recognized as *S. joannis*. Nevertheless, he did not make a formal lectotypification based on that plate. Martinovský and Sckalický (1969) followed Steven's (1857) interpretation and retained *S. pennata* as *S. eriocaulis*, designating a Jussieu's plant as the lectotype, even though it did not represent original material studied by Linneaus. Freitag (1985) selected original material from the van Royen herbarium (L) as the lectotype; this material fit Mansfield's concept of *S. pennata*, restoring the use of this name, which has preference over *S. joannis*. Most subsequent authors (Moraldo and Ricceri 2003; Vázquez & Devesa 1996) have followed Freitag's designation, which is the one followed in the present paper.

Stipa pennata is the most widespread and polymorphic of the three taxa belonging to subsection *Stipa*. The most distinctive character of *S. pennata* is the marginal rows of hairs ending 2-5 mm below the top of the lemma. Endtmann (1962) described *Stipa joannis* subsp. *germanica* and var. *marchica* from plants collected in Geesower and Gartz (Germany), both of which are characterized by a marginal rows of hairs reaching the lemma apex. Despite that, specimens with the marginal row reaching the lemma apex and ending 2-5 mm before the lemma apex are found within single single speimens, indicating this trait is not a good trait for species delimitation. We thus consider *S. joannis* subsp. *germanica* and var. *marchica* as synonyms of *S. pennata* subsp. *sabulosa*. This taxon is highly variable especially in the leaf ornamentation, and numerous varietal and subspecific names have been applied to plants of this species. The abaxial surface of the basal leaves ranges from glabrous to minutely scabrous, whereas the adaxial surface can be scabrous, pubescent or sparsely pilose. We could not find any relationship between geographical distribution and leaf ornamentation and therefore no infraspecific taxa were recognized.

Stipa pennata can be easily distinguished by the presence of an apical tassel of delicate hairs on the young leaves. However, these hairs are deciduous or may not develop in some populations. Specimens lacking those hairs have been treated as *S. lejophylla*, but such variation is frequently found over the whole area of distribution, being considered a variable character, and of little taxonomic value (Freitag 1985).

The plants that have been recognized as *S. anomala* (= subsp. *pennata*) and *S. danubialis* (=subsp. *sabulosa*), exhibit a hairy column. However, individuals with hairy

columns occur within populations of individuals with glabrous columns. For this reason they have been considered mutational forms that are distributed throughout its distribution area (Scholz 1985).

3. STIPA TURKESTANICA Hack., Acta Horti Petrop. 26: 59. 1906.—TYPE: TAJIKISTAN. Shugnan, Dshidak, in valle fl. Badam-dara, 27 Jul 1904, *Fedtschenko s.n.* (holotype: W!)

Herbs 15-65 cm high, perennial, caespitose; branching intravaginal. Culms 2-3 noded, nodes glabrous (rarely pubescent), violet; culm internodes scabrous, pubescent (rarely glabrous). Basal leaves 11-51 cm long, green and occasionally pruinose; leaf-sheaths glabrous, papillose, scabrous or minutely pubescent, margins glabrous or ciliate, cilia 0.1-1 mm long; leaf-blades 8-41 cm long, (0.2)0.3-0.5(0.7) mm in diameter, convolute, abaxial surface distinctly scabrous or with sparsely stiff hairs, adaxial surface scabrous, minutely pubescent or pubescent, hairs (0.02)0.04-0.22(0.28) mm long, leaf-blades apex acute, usually glabrous; ligules (0.5)0.9-6.7(10.2) cm long, truncate, rounded, acute or lanceolate, glabrous, scabrous or pilose, ciliate (rarely glabrous), cilia (0.05)0.09-0.38(0.5) mm long. Floriferous culm leaves 14-40 cm long; leaf-sheaths 12-36 cm long, somewhat scabrous with stiff hairs near the leaf-blades and the margins, glabrous, papillose, margins glabrous; leaf-blades 1-10 cm long, (0.14)0.18-0.4(0.5) mm in diameter, abaxial surface scabrous or with sparsely stiff hairs, adaxial face pubescent or minutely pubescent (rarely scabrous), hairs (0.03)0.04-0.22(0.36) mm long; ligules (0.8)1.1-5(20) mm long, obtuse, rounded, acute or lanceolate, scabrous or glabrous, margins glabrous, tip glabrous or ciliate, cilia (0.02)0.05-0.3(0.4) mm long. Panicles 6-27 cm long, contracted, exserted or partially enclosed by the upper leaf-sheaths, 3-5(7) noded; basal internode (1.4)4.7-16(28) cm long, scabrous (rarely pilose with hairs 0.07-0.41 mm long); branches (0.7)1.1-3.2(4.3) cm long, erect or almost erect, usually setulose, setae (0.02)0.05-0.55(0.79) mm long; basal nodes with (1)2 branches with 1-2 spikelets each. Glumes subequal, lanceolate, acuminate, glabrous or ciliate on the central nerves, cilia (0.09)0.15-0.7(1.1) mm long, green with purple stains, margins and tip hyaline, the lower (2.4)3.4-5.5(6.5) cm long and 3-5 nerved, the upper (2.3)3.2-5.1(6) cm long and 5-7 nerved. Anthecium (8.3)10.4-14.4(14.8) mm long, (0.6)0.7-1.3(1.5) mm wide, fusiform, coriaceus, green, pale or brown; lemma (6.7)8.5-11.7(12.2) mm long, near the apex glabrous or aculeate, the ventral rows ending (0.8)1.2-3.9(4.5) mm below the top, the dorsal row measuring ± 1/2-1/3 the length of the lemma, the remainder rows shorter or equaling the dorsal row, rows with appressed to almost patent hairs (0.3)0.5-0.9(1.2) mm long; callus (1.6)1.8-3(3.2) mm long, acute, curved, villous, hairs (1.1)1.2-2(2.3) mm long on the ventral face and 0.7(0.8)1.4(1.7) mm long on the dorsal face, scar elliptic, peripheral ring (0.6)07-1(1.1) mm long, (0.2)0.23-0.32(0.34) mm wide (ratio width/length= (0.25)0.27-0.37(0.43)); palea (6.8)8.4-11.3(12.1) mm long, lanceolate, margins and tip hyaline, dorsally 2-nerved, between the two nerves papillose or glabrous (rarely with a dorsal row of hairs up to 1/4 the length of the palea), margins glabrous and tip glabrous (rarely ciliate), pale, brown

or green; lodicules 3, equal or subequal, with the dorsal ones slightly longer or shorter than the ventral one, acute, lanceolate or linear laceolate, membranous, glabrous, dorsal lodicules (1.5)1.7-2.9(3.7) mm long, ventral lodicule (1.3)1.9-3.3(3.9) mm long. Awn (9.6)10.6-24.5(28.7) cm long, bigeniculate; column (2.3)2.8-5.3(5.4) cm long, base (0.31)0.35-0.57(0.62) mm in diameter, twisted, pale, brown, brown and green, and frecuently with purple stains, glabrous or scabrous (rarely pilose); geniculation (0.8)1-1.7(1.9) cm long, glabrous, scabrous or with scattered hairs; seta (6.2)7.8-20.6(23.3) cm long, (ratio column length/seta length = (0.17)0.19-0.44(0.55)), flexuous, plumose, hairs in lower part (3.6)4.5-6(6.2) mm long. Anthers (3.6)4.5-6.8(8.3) mm long, glabrous. Ovary glabrous, styles 2. Caryopsis (4)6.1-9.6(9.9) mm long, fusiform; embryo1-3.18(3.05) mm long.

a. subsp. TURKESTANICA

Stipa tzveleviana Kotuch, Bot. Zhurn. (Moscow & Leningrad) 79: 102. 1994.—TYPE: KAZAKHSTAN. Saur-Tarbagatai, brachia australi-occidentalia jugi Manrak, 11 Jul 1992, *Kotuchov s.n.* (holotype: LE!).

Stipa kazachstanica Kotuch, Bot. Zhurn. (Moscow & Leningrad) 79: 104. 1994.—TYPE: KAZAKHSTAN. Saur-Tarbagatai, praemontia australi-occidentalia jugi Manrak, locus Sarybulak, 12 Jul 1992, *Kotuchov s.n.* (holotype: LE!).

Herbs 15-53 cm long. Basal leaves 12-43 cm long; leaf-blades abaxial surface distinctly scabrous, adaxial surface, minutely pubescent, papillose or with scattered hairs, apex glabrous (rarely with a tassel of hairs); ligules 1.6-5.8(6.7) mm long, glabrous or scabrous, margins usually glabrous, tip glabrous or ciliate. Culms leaf-sheaths papillose or glabrous. Glumes (2.3)3-4.4(4.6) cm long. Anthecium (8.3)9.6-11.9(12.2) mm long; lemma (6.7)7.8-10(10.8) mm long, with seven distinct rows of hairs. Callus (1.6)1.8-2.6(2.8) mm long, villous, scar elliptic, curved. Awn (9.6)9.7-17(18.4) cm long; column glabrous, tuberculate or minutely scabrous. (Fig. 12 a-j)

Chromosome Number—2*n*= 44, Sheidai et al. 2006; 2*n*= 40, Freitag 1985.

Habitat and Distribution—This species grows on gravelly hills, stony, sandy or aleurite slopes, and open mountain communities, 1700-4600 m. It is found on high mountain ranges of Alburz and Kopet Dagh in northern Iran, Afghanistan, North Pakistan, and Kashmir (India); in Central Asia, it is distributed from Pamir and the southern range of the Alai mountains, rarely reaching East Kazakhstan at Saur-Tarbagatai range (Fig. 13).

Phenology—Flowering specimens have been collected in May, June, July and August.

Representative Specimens Examined—AFGHANISTAN. Badakhshan: Wakhan, östlicher Oberlauf des Darya-e Istmoch (Toli Bay Tal), 72° 57´ N 37° 8´ E, 6 Aug 1971, *Anders s.n.* (M). Ghazni: Berge südöstlich der Dashti-Nawar (Serpelo Buli), 33° 32´ N 67° 47´ E, 17 Jul 1967, *Freitag 1514* (M); 12,5 miles N of Ghazni, road to Dasht-i-Nawar, 33° 41´ N 68° 29´ E, 30 Apr 1971, *Grey-Wilson & Hewer 662* (K, W); Malestan Distr. Inter Maridina et jugum Ghouch Kol, N Sang-i Masha, 33° 30´ N 67° 5´ E, 2 Jul 1962, *Rechinger 17627* (W). Kabul: Gipfel im Korogh-Massiv, 33° 59´ N 70° 42´ E, 13 Jul 1951,

Gilli s.n. (W); Eingang zur Tang-i-Gharu, 25 km O von Kabul, 34° 33´ N 69° 40´ E, 18 May 1977, *Podlech 30256* (G, M). Kapisa: Nedjerau-Tal bei Bagrami, 34° 58´ N 69° 15´ E, 27 Jun 1951, *Neubauer s.n.* (M, W); Bagrami, Nedjerau-Tal, im Talaschluss, 34° 58´ N 69° 15´ E, 27 Jun 1951, *Neubauer 294* (W, K). Nangarhār: Montes Safed Kuh, in montibus E jugi Altimur, 33° 44´ N 69° 11´ E, 7 Jul 1965, *Rechinger 32005* (B, G, M, W). Paktiyā: Umgebung von Urgun, 32° 54´ N 69° 9´ E, 30 May 1971, *Volk 71/211* (M); Saroti Ghar, Pabhöhe Wee Parei am dem Weg von Waza nach Sayd Karam, 33° 41´ N 69° 21´ E, 20 Jun 1971, *Volk 71/369* (M); Prov. Maidan, umgebung von Qol-e Mazar, 34° 26´ N 68° 3´ E, 11 Jun 1973, *Anders 10251* (G). INDIA. Jammu and Kashmīr: Tibet Occ.(Kashmir), *Thomson s.n.* (NY); Chupursan valley. upwards E end Reshith., 34° 14´ N 74° 39´ E, 2 Aug 2000, *Eberhardt 8798* (GOET); Near Kargil, Ladakh, 34° 34´ N 76° 6´ E, 3 Jul 1976, *Billiet & Leonard 6781* (BR). KYRGYSTAN. Jalal Abad: Ala-Bukinskiy District, Chatkal'skiy Range, Upper reaches of Mazar-su River, 41° 23´ N 71° 30´ E, 17 Aug 1962, *Pavlov 181* (LE, H). Osh: Alai, the 12th km from Irkeshtam on the way to Sarp-Tash, mountains on the left bank of river Kyzyl-Su, 39° 41´ N 73° 55´ E, 25 Jul 1955, *Stanyukovich et al 2176* (LE). PAKISTAN. Azad Jammu and Kashmir: Sheminjerav valley´s end, 74° 48´ N 36° 41´ E, 4 Jul 2000, *Eberhardt 7323* (GOET); Middle Khorperien valley, 74° 48´ N 36° 39´ E, 8 Jul 2000, *Eberhardt 7885* (GOET). Balochistān: Hazarganji Nala, Gasht, 29° 24´ N 63° 23´ E, 2 May 1997, *Rubina Rafiq and Sikander Hayat HG-97-102* (W); Kangri Nala-Nam Tal-Kumbi Top Gasht, 29° 51´ N 67° 13´ E, 18 Jun 1997, *Rubina Rafiq, Sikander Hayat HG-97-368* (MSB, W); Quetta, haut vel de l´Hanne, 30° 11´ N 67° 0´ E, 1 May 1953, *Schmid 128* (G). Khyber Pakhtunkhwa: Tangola, Purig (Kashmir), 35° 36´ N 71° 52´ E, 25-27 Jul 1933, *Koelz 6046* (S); Chitral, Rosh Gol, NE of Tirich Mir, 36° 15´ N 71° 50´ E, 5 Jul 1958, *Stainton 2806* (E, W). TAJIKISTAN. Gorno-Badakhshan: Valley of River Duzah-Dara, Dzhaushataz vallet at 3 km from the river mouth, 37° 21´ N 72° 18´ E, 11 Aug 1959, *Ikonnikov 10562* (LE); Area of Sarez Lake, southern bank of Sarez Lake, 1.5 km east of Nisordaht river, 38° 12´ N 72° 45´ E, 16 Aug 1958, *Gusev 5755* (LE); Western Pamir. Ravine of the river Gunt, near Chartymskiy Waterfall, 37° 29´ N 71° 29´ E, 10 Jul 1948, *bad handwriting 863* (LE); Wakhan-Ishkashimskiy District, S slopes to the Pyandzh river near Nishgar, 37° 1´ N 72° 28´ E, 14 Aug 1935, *Ovchinnikov & Afanasiev 1964* (LE); Shugnanskiy district, slopes to the river Pyandzh between Povodol and Gordzhak, 37° 24´ N 71° 29´ E, 4 Jun 1935, *Ovchinnikov & Afanasiev 187* (LE); Upper reaches of river Shah-dara, W Pamir, Khorog, vicinity of the Botanical Garden, 37° 29´ N 71° 33´ E, 1 Jun 1943, *Nepli s.n.* (LE); Andarob, the valley of river Garm-Chashma (left bank), 5 km above Dasht village, 37° 15´ N 71° 29´ E, 9 Jul 1971, *Sultanov 238* (LE); Wakhan,from Lake Zhui to Zung village, 37° 2´ N 72° 37´ E, 17 Jun 1914, *Tuturin & Bessedin 291* (LE); river Toguz-Bulak, Mordzh village, 37° 42´ N 72° 26´ E, 19 Jul 1962, *Ikonnikov 14026* (LE).

b. subsp. TRICHOIDES (P.A. Smirn.) Tzvelev, Novosti Sist. Vyssh. Rast. 11: 17. 1974; *Stipa trichoides* P.A. Smirn., Repert. Spec. Nov. Regni Veg. 21: 233. 1925.—TYPE: TURKMENISTAN. Turcmenia, Ludsha near Ashkhabad, *Litvinov 2222* (holotype: LE!).

Herbs 22-65 cm long. Basal leaves 14-37 cm long; leaf-blades abaxial surface distinctly scabrous, adaxial surface minutely pubescent, papillose or with scattered hairs, apex glabrous (rarely with a tassel of hairs); ligules 0.5-1.4(1.5) mm long, pilose, scabrous or glabrous, margins and tip usually ciliate. Culms leaf-sheaths papillose or glabrous. Glumes 3.5-4.5(5.3) cm long. Anthecium (11)11.5-14.4 mm long; lemma 9.1-12.7(13.4) mm long, with seven distinct rows of hairs. Callus (2)2.1-2.9(3.2) mm long, villous, scar elliptic, curved. Awn (13.4)13.6-20.1(21.1) cm long; column glabrous (Fig. 12 k-p).

Chromosome Number—2*n*= 40, Chopanov & Yurtsev 1976.

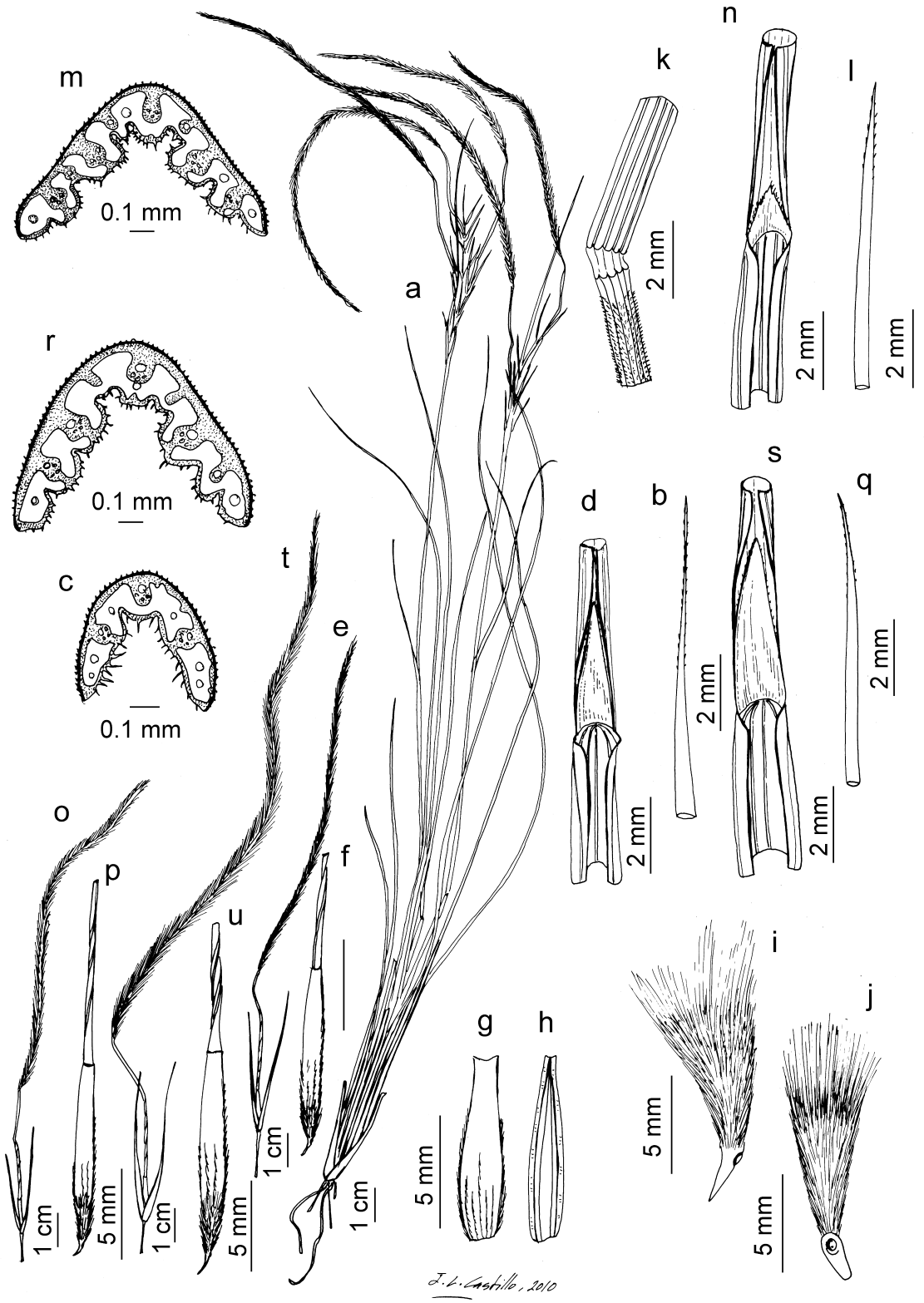


FIG. 12. *Stipa turkestanica* subsp. *turkestanica*. a. Habit. b. Basal leaf apex. c. Transversal section of the leaf-blade. d. Basal leaf ligule. e. Spikelet. f. Anthecium. g. Lemma. h. Palea. i. Callus, lateral view. j. Callus, ventral view. *Stipa turkestanica* subsp. *trichoides*. k. Culm node. l. Basal leaf apex. m. Transversal section of the leaf-blade. n. Basal leaf ligule. o. Spikelet. p. Anthecium. *Stipa turkestanica* subsp. *macroglossa*. q. Basal leaf ligule. r. Transversal section of the leaf-blade. s. Basal leaf ligule. t. Spikelet. u. Anthecium. [based on: a-j. *Rechinger 32005* (S); k-p. *Volk 71/242* (M 0139358); q-v. *Smirnow*, 14 Jun 1931 (H 1086827)].

Habitat and Distribution—Inhabits detrital-sandy, grained-gravelly slopes, and open communities from low mountains belt up to the peak, 700-4000 m. Ranges from the mountains of North Afghanistan, to the Pamir region, Alai Mountains and the western Turkestan range, also occuring in isolated mountains of Turkmenistan (Kopet Dagh) and south eastern Kazakhstan (Fig. 13).

Phenology—Flowering specimens have been collected in May, June, July and August.

Representative Specimens Examined—AFGHANISTAN. Bāmyān: Band-i-Amir, Hänge des edacel-Tales zwischen Zulfikar-See und des Strasse, 34° 48´ N 67° 11´ E, 25 Jul 1971, *Dieterle 1350* (M); (loc. 215.) ca. 15 Km E of Band-i-Amir, 34° 48´ N 67° 11´ E, 18 Jul 1972, *Kukkonen 7263* (H). Kabul: Umbegung von Kabul, 34° 31´ N 69° 11´ E, 6 Jun 1971, *Volk 71/242* (M); Band e Amir, 34° 25´ N 69° 23´ E, 28 Jun 1952, *Volk 2773* (W). Nūristān: Zwischen Waigelek und Bardadesch, am Spuk pass, 35° 18´ N 70° 50´ E, 13 Jul 1935, *Kerstan 1197* (W). Paktiyā: Prov. Gardez, Montes Safed Kuh, in montibus E jugi Altimur, 33° 44´ N 69° 11´ E, 7 Jul 1965, *Rechinger 32005* (S). KAZAKHSTAN. Almaty: Between the towns of Kapchagay and Taldy-Kurgan, 43° 53´ N 77° 5´ E, 26 May 1976, *Bochantsev & Bochantseva 950* (LE). Qaraghandy: Saur-tarbagatay, NE spurs of Manrak Range, mountains Zhamantau, 44° 55´ N 79° 8´ E, 20 Jul 1993, *Kotukhov s.n.* (LE). KYRGYZSTAN. Osh: Fergana Region, Margelan district, Alai Valley, opposite the tract Kizyl, 39° 24´ N 73° 19´ E, 26 Jun 1913, *Dessiatoff 2199* (LE); Alai, 5 km to the east of Saryk-Mogol, near the road, 39° 48´ N 72° 49´ E, 15 Aug 1961, *Ikonnikov, S. 12499* (LE); Fergana Region, between Osh and pass Kizyl art, Alai valley, 40° 33´ N 72° 46´ E, 1901, *Tulinow s.n.* (LE); Close to the river Tuz-dara, 39° 39´ N 72° 43´ E, 2 Jul 1985, *Korshinsky 5648* (LE). TAJIKISTAN. Gorno-Badakhshan: Basin of river Kaindy, right bank of Kaindy river, 10 km above the mouth of the river, Khorog, 39° 11´ N 72° 16´ E, 18 Aug 1958, *Tzvelev 1499* (LE); Pamir-Alai, Alai Valley, 20 km W of Sary-tash village, 37° 47´ N 74° 16´ E, 19 Aug 1954, *Polyakov 324* (LE). Khatlon: E slopes of Nishgar river close to the valley of river Pyandzh, 37° 6´ N 68° 19´ E, 14 Aug 1935, *Ovchinnikov & Afanasiev 218* (LE); Hissar Range , vicinity of the pass Anzob, 1.5 km to the east of the meteorological station, 39° 5´ N 68° 52´ E, 7 Sep 1954, *Kameshkina 163* (LE); Trans-Alai Range, first right tributary of Sauk-dara, 39° 15´ N 72° 30´ E, 27 Jul 1968, *Grubov 422* (LE); Hissar Range, headwater of Somang River to the south of Iskander-kul lake, 39° 4´ N 68° 21´ E, 2 Sep 1933, *Gordienko & Chilikina 473* (JE); Petri Magni (karategin orientalis) locus Fupezck, 38° 34´ N 68° 49´ E, 10 Aug 1935, *Grigorjev 119* (S). TURKMENISTAN. Ahal Turkmenistan: The top Chapan-dag, 37° 48´ N 58° 2´ E, 19 Jul 1928, *Yarmolenko & Gontscharow 1120* (LE).

c. subsp. **macroglossa** (P.A. Smirn.) R. Gonzalo. comb. nov.

Basion. *Stipa macroglossa* P.A. Smirn.,Bot. Mater. Gerb. Glavn. Bot. Sada RSFSR 5: 47. 1924.—TYPE: KAZAKHSTAN. Turgaisky district and post, Kizyl-Jingilskaya Volost, Sarysu River in its lower reaches, environs of Muyunkum, 1 Jun 1914, *Kransheninnikov 5203* (holotype: LE!; isotype: W!)

Stipa kungeica Golosk., Bot. Mater. Gerb. Glavn. Bot. Sada RSFSR 16: 39. 1954.—TYPE: KAZAKHSTAN. Kungei Alatau, Tauchilik, 1 Km bellow the fall of Kainda, 9 Jun 1953, *Goloskokov s.n.* (holotype: LE!; isotype: LE!)

Herbs 21-47 cm long. Basal leaves 11-51 cm long; leaf-blades abaxial surface distinctly scabrous, adaxial surface minutely pubescent, pubescent or papillose with scattered hairs, apex glabrous or setulose; ligules (2.3)2.8-9.8(10.2) mm long, pilose, somewhat scabrous or glabrous, margins usually glabrous and tip ciliate. Culms leaf-sheaths usually papillose or scabrous. Glumes (4.2)4.3-5.8(6.5) cm long. Anthecium

(11.9)12-14.6(14.8) mm long; lemma 9.9-12.9(13.8) mm long, with seven distinct rows of hairs. Callus (2)2.4-3.1(3.2) mm long, villous, scar elliptic, curved. Awn (18)20-27(29) cm long; column glabrous or scabrous. (Fig. 12 q-v).

Chromosome Number—unknown.

Habitat and Distribution—Dry steppes, stony and aleurite slopes and occasionally on sands and clays, from lowlands to middle mountain belts, 400-2600 m. Distributed from central to east Tian-Shan range, and from central to east Kazakhstan. (Fig. 13).

Phenology—Flowering specimens have been collected in May, June, July and August.

Representative Specimens Examined—CHINA. Xinjiang: Tien Shan, the basin of Kuitun River, right Bank of Bain-gol valley, S of Tushantszy village, 44° 20′ N 84° 44′ E, 29 Jun 1957, *Junatov, Li Shi-in, Yuan' I-fan 505a* (LE); E Tien Shan, the valley of Muzart River, the lowest right tributary of the river Lyangar before leaving Muzart to the Bahia basin, 41° 42′ N 80° 48′ E, 12 Sep 1958, *Junatov & Yuan' I-fan 1019* (LE). KAZAKHSTAN. Akmola: Atbasar uezd. Lower reaches of Sary-su river, vicinity of heights Orta-kasaun, 51° 30′ N 68° 45′ E, 9 Jun 1914, *Krascheninnikov s.n.* (LE); Chu-Ili Mountains.Tract Dzhevan-kezen, 43° 40′ N 75° 1′ E, 7 Jun 1914, Titov *614* (LE); Atbasar District, basin of Beleudty river, headwater of River Dyusenbai (river Dzhideli), 49° 43′ N 65° 45′ E, 19 Jun 1914, *Krascheninnikov 5354* (FI, W). Almaty: Semirechensk Region, Dzharkent uezd, mountains Karatau, rivers Kuru-kul'dek-Sumbe, 45° 1′ N 79° 10′ E, 9 Jul 1910, *Mikhelson 1978* (LE); Sarydzhas village, 42° 54′ N 79° 36′ E, 17 Jul 1934, *Shischkin s.n.* (LE); Spurs of Dzhungarskiy Ala-Tau. Mountains Chulak. Ravine Chulak-Dzhigde, 45° 0′ N 80° 0′ E, 6 May 1956, *Goloskokov s.n.* (LE); Kungei Ala-Tau, Tau-Chilik 1 km below the confluence of Kaindy river, 42° 50′ N 77° 30′ E, 9 Jun 1953, *Goloskokov s.n.* (LE); Turgai region. Kizil-dzhigil'skaya Parish, Sary-su river, vicinity of Muyunkumy, 43° 39′ N 76° 54′ E, 1 May 1924, *Krascheninnikov 5203* (WU). East Kazakhstan: Manra Range, tract Sary-Bulak, 47° 25′ N 82° 25′ E, 12 Jun 1992, *Kotukhov 10* (LE). Karagandy: Taldy-Kurganskiy uezd, near Aina-bulak stream, 47° 40′ N 71° 0′ E, 10 Jun 1928, *Pavlov 79* (LE). Zhambyl: Flora Iliensis. Kenduktas, 44° 13′ N 73° 48′ E, 1886, *Krassnow s.n.* (LE)**;** Semirechensk Region, Chu-Ili Mountains, Chok-par valley, 43° 7′ N 74° 51′ E, 18 Jun 1914, *Titov 1144* (LE)**;** Pishpek uezd near the tract Kokuyrak, 44° 33′ N 72° 16′ E, 26 Jun 1913, *Shischkin & Genina s.n.* (LE)**.** KYRGYZSTAN. ISSYK-KUL: Issyk-Kul Region, village Pokrovka, at 12 km S of the village, on the right bank of Chon-Kyzyl-Su river, 42° 19′ N 78° 5′ E, 1 Aug 1960, *Kurganskaya & Udintseva 536* (W); Tian Shan centralis, Lacum issyk-kul prope pag Tschoktal, 51° 13′ N 77° 21′ E, 14 Jun 1931, *Smirnow 32* (B, E, G, H, FI, JE, L, S, W); Loess hills on the southern bank of Issyk-kul' near the river B. Dzhirgalchak, 42° 36′ N 78° 33′ E, 24 Jun 1908, *Rozhevitz 644* (LE).

Notes—*Stipa turkestanica* is widely distributed in Central Asia, covering a broad altitudinal range, which is translated into a rather variable size. *Stipa turkestanica* resembles a very delicate *S. pennata* (Freitag 1985), with smaller reproductive parts. Furthermore, some specimens of *S. turkestanica* show an apical tassel of hairs on the apex of the basal leaves, just like *S. pennata*. Besides the smaller size, *S. turkestanica* may be distinguished by the distinct rows of the lemma, distinctly scabrous abaxial surface of the basal leaves, and the pilose or scabrous culm internodes, whereas *Stipa pennata* has the dorsal and subdorsal rows slightly fused at the base, with the abaxial surface of the basal leaves glabrous or scabrous, and the culm internode usually glabrous.

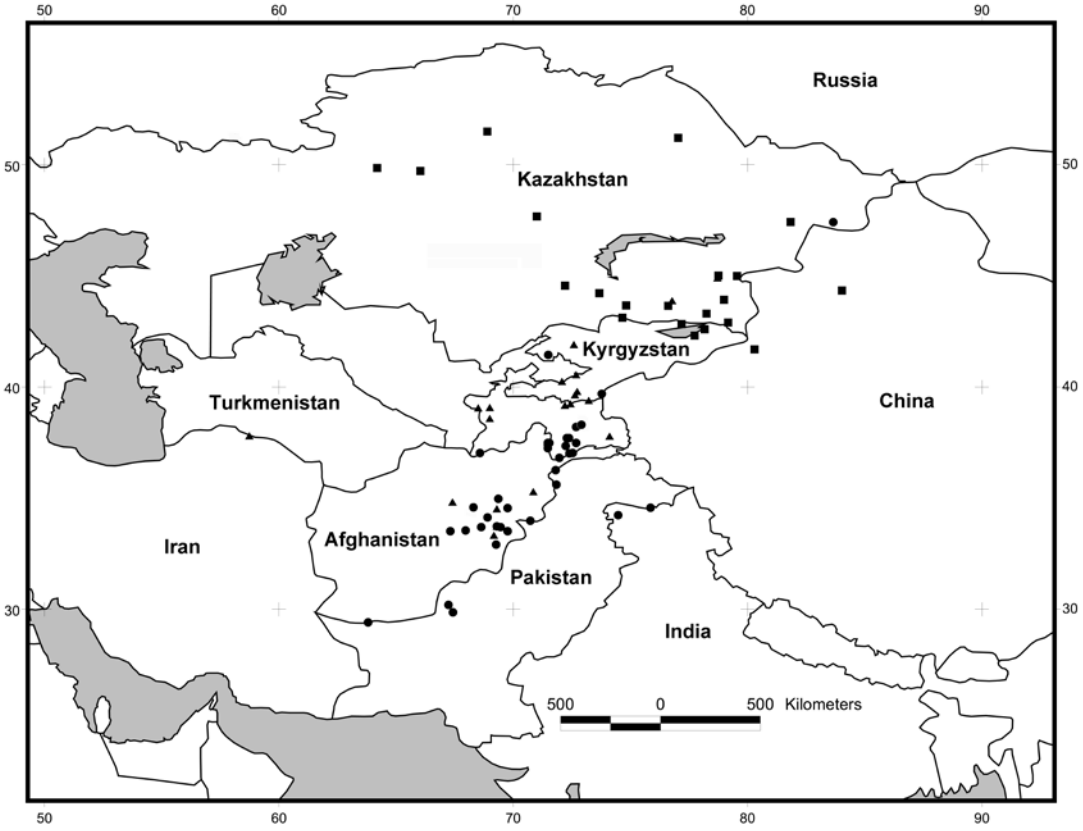


FIG. 13. Distribution map of *S. turkestanica* subsp. *turkestanica* (●), *S. turkestanica* subsp. *trichoides* (▲), *S. turkestanica* subsp. *macroglossa* (■).

4. *Stipa kirghisorum* P.A. Smirn., Repert. Spec. Nov. Regni Veg. 21: 231. 1925; *S. pennata* subsp. *kirghisorum* (P.A. Smirn.) Freitag, Notes Roy. Bot. Gard. Edinburgh 42: 438. 1985.—TYPE: KAZAKHSTAN. Prov. Semipalatinsk, m. Bokaj, *Kossinsky s.n.* (holotype: MW)

Stipa violacea E. Nikit., Tr. Biol. Inst. Kirg. Fil. AN SSSR 2: 68. 1947, nom. illeg.; *S. kirghisorum* var. *violacea* E. Nikit. ex Tzvelev, Novosti Sist. Vyssh. Rast.: 16. 1974.—TYPE: KYRGYZSTAN. Central Tian Shan, declivitas borealis jugi Kavaktau, 28 Jul 1937, *Michajlova* & *Popova 66* (holotype: LE!)

Stipa ikonnikovii Tzvelev, Spisok Rast. Gerb. Fl. S.S.S.R. Bot. Inst. Vsesoyuzn. Akad. Nauk 21: 49. 1977.—TYPE: TAJIKISTAN. Badachsan, ad ripam dextram fl. Gunt, Czartym, 5 Aug 1957, *Ikonnikov 5654* (holotype: LE!; isotype: C!, H!, JE!, M!, NY!)

Herbs 22-72 cm high, perennial, caespitose; branching intravaginal. Culms 2-3(4) noded, nodes glabrous, violet; culm internodes scabrous or pubescent. Basal leaves 23-58 cm long, green and occasionally pruinose; leaf-sheaths minutely pubescent, papillose or scabrous, usually glabrous; leaf-blades 19-36 cm long, (0.3)0.35-0.56(0.63) mm in diameter, convolute, abaxial surface distinctly scabrous by prickles, adaxial surface papillose, scabrous, pubescent or minutely pubescent, hairs (0.04)-0.4(0.45) mm long, leaf-blades apex acute, glabrous; ligules (0.25)0.42-1.7(2.5) cm long, rounded,

obtuse or acute, usually scabrous, ciliate or ciliolate, cilia (0.03)0.04-0.28(0.47) mm long. Floriferous culm leaves 24-37 cm long; leaf-sheaths 21-31 cm long, scabrous, minutely scabrous or glabrous, margins glabrous; leaf-blades 1.5-8.3 cm long, (0.17)0.19-04(0.7) mm in diameter, abaxial surface scabrous, adaxial surface papillose, scabrous, pubescent or minutely pubescent, hairs (0.03)0.07-0.31(0.47) mm long; ligules (0.43)1-3.8(4.9) mm long, acute, obtuse or rounded, usually scabrous, ciliate or ciliolate (rarely glabrous), cilia (0.03)0.07-0.31(0.47) mm long. Panicles 11-48 cm long, contracted, exerted or partially enclosed by the upper leaf-sheaths, 3-5 noded; basal internode (4.9)6-28(38) cm long, pubescent (rarely scabrous); branches (1)1.6-3.3(4.2) cm long, erect or almost erect, setulose, setae (0.13)0.17-0.94(1.16) mm long; basal nodes with (1)2 branches with 1(2) spikelets each. Glumes subequal, lanceolate, long acuminate, glabrous or ciliate on the central nerves, cilia (0.1)0.13-0.17(1.2) mm long, green with purple stains, margins and tip hyaline, the lower (3.7)4-5.6(6) cm long and 3-5 nerved, the upper (3.5)3.7-5.3(5.6) cm long and 5-7(9) nerved. Anthecium (13.7)14.3-17.5(18.5) mm long, (0.8)0.9-1.3(1.4) mm wide, fusiform, coriaceous, green or brown; lemma (11.2)11.3-13.9(14.8) mm long, near the apex glabrous, with 7 distinct rows of hairs (rarely fused at the base), the ventral rows ending (0.35)0.75-314(3.67) mm below the top (rarely reaching the top), the dorsal row measuring 2/4-3/4 the length of the lemma, the remainder rows slightly shorter or ± equalling the dorsal row, rows with appressed to almost erect hairs (0.67)0.7-0.98(1.02) mm long; callus (2.42)2.64-3-75(3.9) mm long, acute, curved, villous, hairs (1.45)1.8-2.46(2.75) mm long on the ventral face and (1)1.1-1.6(1.9) mm long on the dorsal face, scar elliptic to broadly circular, peripheral ring (0.74)0.76-1.06(1.17) mm long, (0.21)0.24-0.35 mm wide (ratio width/length= (0.25)0.27-0.37(0.38)); palea (10.4)11-13.6(14.8) mm long, lanceolate, margins and tip hyaline, dorsally 2-nerved, between the two nerves papillose or glabrous, margins glabrous and tip glabrous or ciliate, rarely with a dorsal row of hairs, brown or green; lodicules 3, equal or subequal, with the dorsal ones slightly longer or shorter than the ventral one, acute, lanceolate or linear lanceolate, membranous, glabrous, dorsal lodicules (1.6)2.1-3.2(3.5) mm long, ventral lodicule (1.8)2.2-3.5(4.2) mm long. Awn (19.6)20.7-26.5(27) cm long, bigeniculate; column (4.4)4.8-7(7.5) cm long, base (0.37)0.4-0.6(0.7) mm in diameter, twisted, brown, brown and green and frequently with purple stains, glabrous or tuberculate; geniculation (1.1)1.4-2.2(2.5) cm long, glabrous, tuberculate or scabrous; seta (14.4)15.2-19(20) cm long, (ratio column length/seta length = (0.26)0.28-0.42(0.43)), flexuous, plumose, hairs in lower part (3.2)4-5.7(5.89) mm long. Anthers (3.8)4.6-8.2(9.1) mm long, glabrous (rarely with scattered hairs), yellow or purple. Ovary glabrous, styles 2. Caryopsis (7.4)8.1-9.9(10.01) mm long, 2; embryo (1.2)1.5-2.1(2.3) mm long. (Fig. 14).

Chromosome Number—2*n*=32 Freitag 1985; Tzvelev 1976.

Habitat and Distribution—Steppes, debris and rocky slopes, from lowlands up to middle mountain belts, 1200-4300 m. North-east Afghanistan, North-west Turkey, Kashmir (India), Pamir and Alai mountains, Tian Shan range, Central and East Kazakhstan, Xinjiang, West Mongolia and western and central Siberia. (Fig. 15).

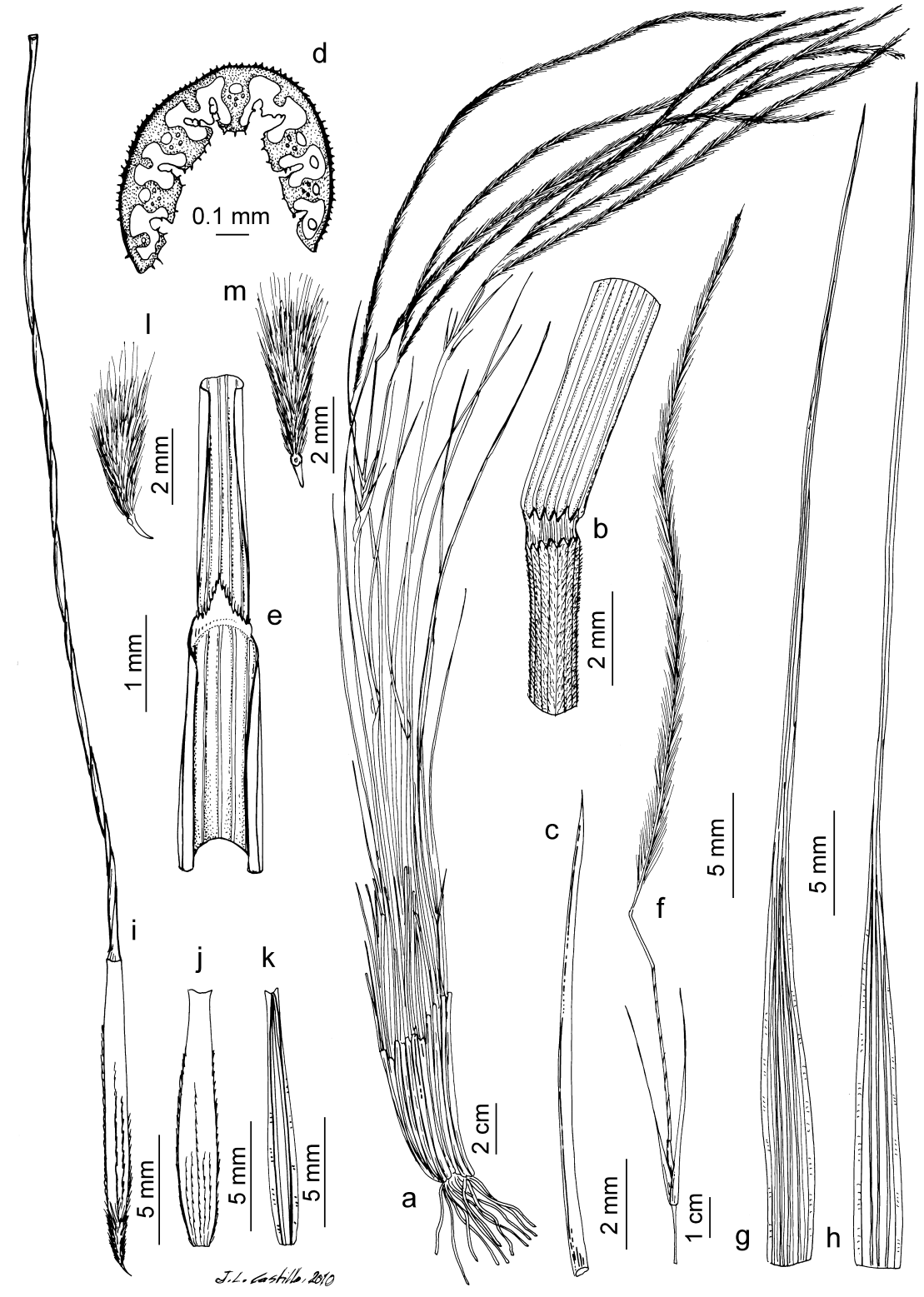


FIG. 14. *Stipa kirghisorum.* a. Habit. b. Culm node. c. Basal leaf apex. d. Transversal section of leaf-blade. e. Basal leaf ligule. f. Spikelet. g. Upper glume. h. Lower glume. i. Anthecium and column. j. Lemma. k. Palea. l. Callus, lateral view. m. Callus, ventral view. [based on: *Smirnow 29* (JE)].

Phenology—Flowering specimens have been collected in June, July and August.

Representative Specimens Examined—AFGHANISTAN. Badakhshan: Darrah-i-Parshui (Centr Afgh. Hindukusch) orogr. Rechter ast., 36° 53′ N 73° 15′ E, 12 Aug 1965, *Frey 414* (W); Wakhan, oberes Baroghil Tal und Baroghil PaB, 36° 53′ N 73° 22′ E, 30 Jul 1971, *Anders 7883* (M). Nuristan: Ost-Nuristan, West-Seite des Semenek-Passes, 34° 57′ N 70° 24′ E, 1 Aug 1960, *Kerstan 1509* (W); Nuristan, Vaigel, 34° 57′ N 70° 24′ E, 1949, *Edelberg 2034* (C). Parwan: Parwan, Summer valley, 35° 0′ N 68° 55′ E, 18 Jul 1965, *Gilbert 32* (K). CHINA**.** Xinjiang: Eastern Tien Shan, basin Kuitun, Right Bank of Bain-gol valley, S of Tushantszy, 44° 20′ N 84° 51′ E, 29 Jun 1957, *Junatov, Li Shi-in, Yuan' I-fan 530* (LE); Eastern Tien Shan, Ili Valley, Ketmen-tau Range, 3-4 km above the Sarbushin village on the road from Kul'dzhi to Kyzyl-kure, 44° 14′ N 84° 48′ E, 23 Aug 1957, *Junatov, Li Shi-in, Yuan' I-fan 1438* (LE). INDIA**.** Jammu and Kashmīr: SE oberh. Matayan/Ladakh, 34° 22′ N 75° 36′ E, 17 Jul 1976, *Hartmann 2384* (G); Ebene van San modangra (pr. Parkutze u. Julidak) Ladakh, 34° 6′ N 75° 56′ E, 30 Aug 1976, *Hartmann 2383* (G). Himāchal Pradesh: Punjab, Kulu. Lahaul, 32° 30′ N 77° 50′ E, 1 Jun 1888, *Drummond 23332* (E); Chandratal, Lahul, Kangra, Punjab, 32° 10′ N 76° 15′ E, 1 Sep 1933, *Koelz 6924* (GH, S). KAZAKHSTAN**.** Aktobe: Mugodzhary,E Dzhaman-tau, 48° 38′ N 58° 32′ E, 26 May 1927, *Rusanov 167* (LE). Almaty: SW spurs of Dzhungarskiy Ala-Tau, Chulak mountains, Gorge of Kzyl-Aus river, 43° 57′ N 77° 56′ E, 4 Jun 1955, *Goloskokov s.n.* (GH). East Kazakhstan: Semipalatinsk Province, Krasnooktyabr'skaya parish. About 8.5 km from Taubinka, 49° 48′ N 80° 0′ E, 1928, *Enden 159* (NY); Altai,Ustj-Kamenogorsn mons Prigonnaya, 50° 43′ N 81° 46′ E, 29 May 1931, *Schischkin et al. s.n.* (NY); Manrak range. At 15 km from Priozernoe village, 47° 45′ N 84° 11′ E, 2 Jun 1976, *Kotukhov s.n.* (B); Altai,Ustj-Kamenogorsn mons Prigonnaya, 50° 43′ N 81° 46′ E, 29 May 1931, *Schischkin et al. s.n.* (NY). Karagandy: Central Kazakhstan hills (Karaganda Region). 20 km W of Akgatau village to Agadyr village, 48° 15′ N 72° 50′ E, 10 Jun 1964, *Vasilevich et al. 70* (LE). KYRGYZSTAN**.** Chui: Talas Range. The southern macro-slope, Susamyr riverhead, 42° 12′ N 73° 58′ E, 26 Jul 1971, *Ikonnikov S. et al. 7538* (LE); Alai Range. Route Osh-Khorog, the pass "40 years of Komsomol Kigizstan", 21 Aug 1971, *Ikonnikov, S. et al. 8756* (LE). Issyk-kul: Tian Shan central. jugum Kungei-Alatau, fauces Utasch prope pag. Tschoktal, 42° 34′ N 76° 41′ E, 27 Jun 1931, *Smirnow 29* (H, JE, S, W). Naryn: Tian Shan Region, the vicinity of lake Son-kul, near the road to the lake from the side of Tyulek river valley, 41° 50′ N 75° 8′ E, 6 Aug 1960, *Kurganskaya & Udintseva 565* (W); Naryn, 41° 27′ N 75° 59′ E, 26 Aug 1926, *Abolin 1094* (LE). Osh: Fergana Region, Osh uezd, Plain of Alai, near the mouth of Taldyn, 40° 59′ N 73° 33′ E, 30 Jun 1913, *Knorring 684* (LE, NY). Talas: Semirechenskaya Province, Aksu gorge, Aleksandrovskii Range, 42° 37′ N 71° 35′ E**,** 16 Jun 1903, *Lipsky 2355* (LE). MONGOLIA**.** Uvs: Mongolia borealis. Altai. Circa lacus Ubsa, Kirghiz-nor et Kosogol. Ad Ienisei superiorem et jugum Tannu-ola, 50° 20′ N 92° 45′ E, 1-20 May 1879, *Potanin 87* (LE); Altai. Ubsunur region, Hyargas district, 38 km to the north of Mogoi-bulak. The bottom of the dry bed of temporary watercourse, 49° 0′ N 93° 0′ E, 18 Jul 1973, *Banzrych et al. 4761* (LE). PAKISTAN**.** Gilgit-Baltistan: Baltestán Chatpani Nukarh west of Drún, 36° 13′ N 74° 6′ E, 28 Aug 93, *Duthie 13857* (W); Shingo valley, Deosai region, 34° 46′ N 75° 16′ E, 7 Aug 1946, *Stewart, R.R. & Stewart, I.D. 22201* (NY). Khyber Pakhtunkhwa: Prov. Chitral, haute vallée de Yarkhun, 36° 44′ N 72° 52′ E, 22-27 Aug 1954, *Schmid 2335* (G). Punjab: Punjab, 31° 0′ N 76° 0′ E, 17 Jun 1888, *Drummond 23344* (G). TAJIKISTAN. Gorno-Badakhshan: Wakhan-Ishkashimsky District, NE slopes of the river Matz, 36° 43′ N 71° 36′ E, 24 Aug 1935, *Ovchinnikov & Afanasiev 2047* (LE); The south-western spurs of Dzhungarskiy Ala-Tau. Mountains Chulak. Gorge of river Kzyl-Aus, 38° 0′ N 71° 46′ E, 1 Aug 1964, *Ikonnikov, S. 16537* (GH); Eastern Pamir, the northern spurs of the Wakhan Range, basin of river Karadzhilgasai (above the lake Chakankul), 37° 23′ N 73° 49′ E, 9 Jul 1985, *Medvedev 63* (LE); Alai valley, the right bank of Kyzyl-su River, near Lenin Peak, 39° 20′ N 72° 52′ E, 24 Jul 1967, *Ladygina et al. 18219* (LE)**;** Basin of upper reaches of river Shah-dara, middle reaches of river Kok-bai, 37° 20′ N 72° 34′ E, 4 Sep 1943, *Nepli s.n.* (LE); Western Pamir, Khorog, vicinity of the Botanical Garden, 37° 29′ N 71° 33′ E, 28 May 1943, *Nepli s.n.* (LE); Andarab, the valley of Garm-Chashma river, 38° 26′ N 71° 51′ E, 14 Jul 1971, *Sultanov 528*

(MA, W). TURKEY. Rize: Aufstieg auf eine Alm knapp SE fundort: des Kackar Hauptkammes, beginnend 10 km oberhälb Sargöl, 40° 50´ N 41° 9´ E, 20 Jul 1982, *Sorger & Buchner 82-84-52* (W).

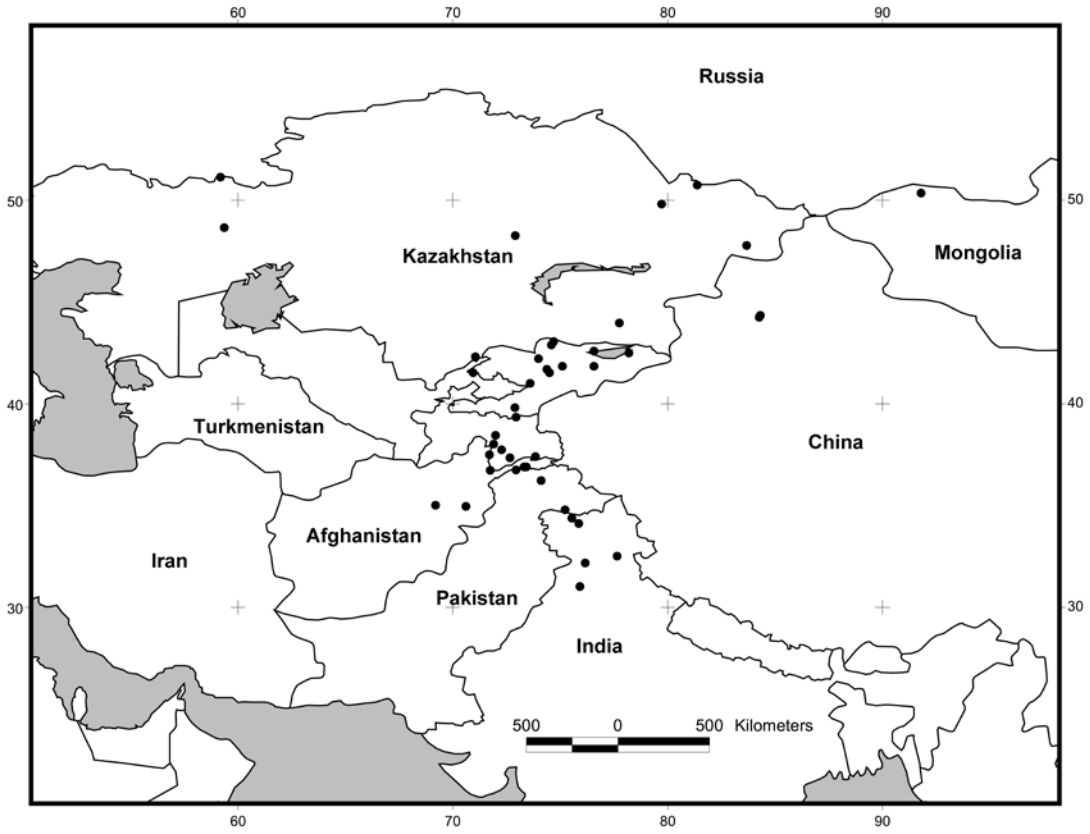


FIG. 15. Distribution map of *S. kirghisorum* (●).

Notes—Tzvelev (1977) described *Stipa ikonnikovii* Tzvelev, endemic to Shugnan (Tajikistan) and distinguished this species from *S. kirghisorum* by the adaxial surface of the basal leaves minutely pubescent and the ventral row reaching the top. Even though *S. kirghisorum* shows rather uniform morphological variation, the ornamentation of the adaxial surface is highly variable. Specimens with scabrous, minutely pubescent or pubescent surface are found throughout its geographic distribution. Likewise, some specimens from Afghanistan present the ventral rows that reaches (or almost reaches) the top, overlapping with the range of variation of this character in *S. kirghisorum*.

EXCLUDED NAMES AND UNIDENTIFIED SPECIMENS

Stipa ammophilla Czern. ex Bordz, Flora URSR 2: 123. 1940, nom. inval., pro syn.

Stipa fallacina Klokov & Osȳchnyuk Novosti Sist. Vyssh. Nizsh. Rast. 1975: 62. 1976. —TYPE: UKRAINE. Donetzica. Steppa reservata Chumotoviensis, 10 Jun 1974, Osȳchnyuk *s.n.* (holotype: KW; isotype: LE!). This taxon is very similar to *S. lessingiana* Trin. & Rupr., from which is distinguished by having seven distinct rows of hairs instead a completely pubescent lemma. The isotype

examined exhibits panicle scarcely developed, and the application of this name is in doubt until the holotype and more material can be examined.

Stipa fontanesii var. *planifolia* Roshev. ex B. Fedtschenko, Izv. Imp. Bot. Sada Petra Velikago. 14(Suppl. 2): 49. 1915. nom. nud.

Stipa hippura Czern, nom. nud. (in sched., LE!).

Stipa kempirica Kotukhov, Bot. Zhurn. (Moscow & Leningrad) 79: 101. 1994—TYPE: KAZAKHSTAN. Saur-Tarbagatai, brachia australi-occidentalia jugi Manrak, locus Kempirbulak, 11 Jul 1992, *Kotuchov s.n.* (holotype: LE!). This taxon is only distinguished from *S. kirghisorum* by its longest awn with shorter seta hairs (2-3 mm long). The application of this name is in doubt until more material can be examined.

Stipa joannis var. *microtricha* Borbás, Balat. Fl.: 316. 1900; *Stipa joannis* [unranked] *microtricha* (Borbás) Jáv. Magyar Fl. 1: 69. 1924.—TYPE. CZECH REPUBLIC. Gys hegyein s a budai Lipótmezon. (type: no original material located).

Stipa joannis f. *okensis* P.A. Smirn., Tabl. Opred. Kovile: 4. 1927; *Stipa pennata* var. *okensis* (P.A. Smirn.) Tzvelev, Novosti Sist. Vyssh. Rast. 11: 19. 1974; *Stipa pennata* subsp. *okensis* F.M. Vázquez & M. Gutiérrez, Telopea 13: 169. 2011.—TYPE: no original material located.

Stipa joannis var. *puberula* Podpera & Suza, Spisy Přír. Fak. Masarykovy Univ. 12: 7. 1922; *S. joannis* subsp. *puberula* (Podpera & Suza) Martinovský, Preslia 48: 172. 1976; *S. pennata* var. *puberula* (Podpera & Suza) Kubát, Severceskou Prir 33-34: 156. 2002; *Stipa pennata* subsp. *puberula* F.M. Vázquez & M. Gutiérrez, Telopea 13: 169. 2011.—TYPE: CZECH REPUBLIC. Mohelno, Jun 1921 *Suza s.n*. (type: no original material located).

Stipa joannis f. *subpuberula* Podpera & Suza, Spisy Přír. Fak. Masarykovy Univ. 12: 7. 1922.—TYPE: CZECH REPUBLIC. Monte Pavlovské: ad rupes calcarias ad declive orientale loci Soutěska (vel Klause). (type: no original material located).

Stipa kleopovii Klokov & Zoz, nom. nud. (in sched., LE!)

Stipa lessingiana var *dubia* Hack. ex Fed., Izv. Imp. Bot. Sada Petra Velikago. 14(Suppl. 2): 48. 1915, nom. nud.

Stipa longifolia Borbás, Magyar Növényt. Lapok 10: 117. 1884.—TYPE: HUNGARY. Kolozsvári, Szénafüveken, Jul 1878 (holotype: no original material found).

Stipa macroglossa f. *pubescent* P. A. Smirn., Repert. Spec. Nov. Regni Veg. 5: 235. 1925.—TYPE: KAZAKHSTAN. Prov. Semirezcje. Distr. Prshewalsk, ad fl. Kugart, *Saposhnikow s.n.* (holotype: original material not located)

Stipa sect. *Parastipa* Klokov, Novosti. Sist. Vyssh. Nizsh. Rast. 1975: 23. 1976. nom prov., nom inval.—TYPE: *Stipa syreistschikowii* P.A. Smirn.

Stipa pennata f. *asperior* Podp. Práce Morav. Přír. Společn. 2: 694. 1926; *Stipa joannis* f. *asperior* (Podp.) Soó, Acta Bot. Acad. Sci. Hung. 17: 123. 1972.—TYPE: CZECH REPUBLIC. Mohelno. May 1921, *Suza s.n.* (holotype: no original material located).

Stipa pennata [2] *apendiculata* Asch. & Graebn., Syn. Mitteleur. Fl. 2: 105. 1898; *Stipa joannis* f. *apendiculata* (Asch. & Graebn.) Soó in Acta Bot. Acad. Sci. Hung. 17: 123. 1972.—TYPE. GERMANY. Selten, bisher nur in der Prov. Brandenburg, *Freinwaldea. O. s.n.* (type: no original material located).

Stipa pennata [A] *eupennata* Asch. & Graebn., Syn. Mitteleur. Fl.: 104. 1899, nom. inval.; *S. pennata* subsp. *eupennata* (Asch. & Graebn.) Hayek, Prodr. Fl. Penins. Balcan. 3: 349. 1932. nom. inval.

Stipa pennata f. *glaucescens* Novak in Preslia 2: 80. 1922; *Stipa tirsa* f. *glaucescens* (Novak) Soó, Acta Bot. Acad. Sci. Hung. 17: 123. 1971.—Type: SLOVAKIA. Montis Blasenstein [prope Plavecký Sv. Mikulás] in Carpathis Minoribus, *Novak s.n* (holotype: no original material found).

Stipa pennata [b] *krauseana* Asch. & Graebn., Syn. Mitteleur. Fl. 2(1): 105. 1899; *Stipa joannis* f. *krauseana* (Asch. & Graebn.) Soó, Acta Bot. Acad. Sci. Hung. 17: 123. 1971.—TYPE: GERMANY. Waldform, bisher nur Prv. Sachsen: Burg: Grabauer Forst, *Eggert s.n.* (holotype: original material not located).

Stipa pennata f. *penicellifera* Pacz. Zlaki Khers. Gub: 21. 1913; *Stipa joannis* subsp. *penicelliferae* (Pacz.) Lavrenko Flora URSR 2: 123. 1940.—TYPE: not found.

Stipa pennata [II] *valida* Asch. & Graebn., Syn. Mitteleur. Fl. 2: 105. 1898; *Stipa joannis* f. *valida* (Asch. & Graebn.) Soó, Acta Bot. Acad. Sci. Hung. 17: 123. 1972.—TYPE: GERMANY. Im nördlichen Gebiet selten. Frankfurt a. *O. Reitweiu s.n.* (holotype: original material not located).

Stipa pinneticola Klokov & Zoz, nom nud (in sched LE!)

Stipa stenophylla Czern., Consp. Pl. Charcov.: 79 .1859., nom. nud

Stipa vulagris Gueldenst., Reis. Russland 2: 39. 1791, nom. inval., pro syn.

ACKNOWLEDGEMENTS. The authors wish to thank the staff of the cited herbaria for their support on our visit and/or loan of material. We are also indebted to Dr. Félix Muñoz Garmendia for his authorized advices in nomenclature, to Dr.Elena Glazcova for the Russian translation, to Dr. Heimo Ryner for his colaboration with the loan of *S. styriaca*, to Dr. Sorin Stefanut for the digital images of *S. danubialis* and to Joel Calvo for the digital images provided. This work was supported by the *Flora iberica* project CGL2008-02982-C03-01/CLI, Ministerio de Educación y Ciencia, Spain. Our visit to the W herbarium was funded by the FPVI European-funded Integrated Infrastructure Initiative grant SYNTHESYS.

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APPENDIX 1: Index to numbered collections cited. The numbers in parentheses refer to the corresponding species in the text.

Aach 10 Jun 1947 (2a), 23 Apr 1951 (2a). *Abolin 196* (4), *1094* (4). *Abramov, Bezak & Kovaleva 352* (4). *Adamovic* 11 Jul 1896 (2a). *Alanko* 2 Jul 1961 (1). *Alpers* Jun 1910 (1). *Anderberg* 3 Jul 1936 (1), 1 Jul 1936 (2a). *Anders 7883* (4), *10251* (3a), 6 Aug 1971 (3a). *André* Jul 1879 (2a), Jun 1894 (2a). *Anhel* Jun 1878 (2a). *Antal* 29 May 1924 (2a). *Aschuz* Jun 81 (2a). *Asplund* 13 May 1927 (2a). *Ausl.* 15 Jun 1922 (2a). *Bach 174* (2a). *Banzrych, Karamysheva, Munhbayar & Tzegmid 4761* (4). *Barth* 29 Jun 1887 (1), 22 Jun 1906 (1). *Basilvev* 22 Jul 1920 (4). *Bauer* 1840 (2a). *Baumgartner 8090* (2a), Jun 1884 (2a). *Beauvard* 22 Aug 1932 (2a), 24 Jul 1934 (2a). *Becker* Jun 1848 (2a), 1882 (2a) 1883 (2a), 1886 (2a). *Berger 2957* (2a), *16735* (2a), *17773* (2a), *19938* (2a), 25 May 1957 (2a). *Bergfaldt* 1881 & 1871 (1). *Berghen* 13 Jul 1975 (2a). *Bergqvist, Eldenäs, Källersjö & Lundin 05* (2b). *Billiet & Leonard 6781* (3a). *Bischoff* 1828 (2a). *Bisse* 23 Jun 1960 (1), 10 Jul 1962 (2a), 29 May 1963 (2a), 7 Jun 1963 (1). *Bochantsev & Bochantseva 950* (3b). *Bodemk. exc.- Th. J. Visser 141* (2b). *Boggiani* 29 Aug 1912 (2a). *Bolle* May 1847 (2a). *Bonnot* 23 Jun 1948 (1), 18 Jul 1961 (2a). *Boom 8695* (2a). *Borbás* 1 Jul 1887 (1), 5 Jul 1877 (1), 31 May 1888 (2a), 22 jun 1895 (1), 4 Jun 1897 (1), 7 Jun 1897 (1), 20 Jun 1897 (1), May 1900 (2a). *Bornmüller 5192* (2a), 1898 (2a), 14 Jun 1916 (2a). *Boros* 28 Jun 1937 (1), 21 Jun 1939 (1), 21 Jun 1942 (1), 15 jun 1947 (1), 9 jun 1949 (1). *Botezoni* 11 Jun 1958 (1). *Branco* 6 Jun 1937 (2a), 22 May 1953 (2a). *Bronevsky 661* (3b). *Brummer-de Vries* 12 Jun 1916 (2a). *Bruynseels* 20 Jul 1975 (2a). *Bunyashina* 6 Jul 1951 (1). *Burri & Krendl* 6 Jul 1982 (2a). *Buxbaum 261* (2a). *Buysman 524* (1). *Buzuk 79* (4), *194-15* (3b). *Callier 219* (1). *Cavalluy* Jul 1875 (2a). *Cedercreutz* 11 May 30 (2a). *Cefrube* 30 Jul 27 (1). *Celakovský* 20 Jul 1886 (1). *Ceynowa-Gieldon 296* (2b), *297* (2b). *Charpin* 19 Jun 1960 (2a), 9 Jul 1967 (2a). *Chernova 209* (1). *Cofrubay Jun* 1926 (1). *Colrube* 5 Jul 1911 (1), 30 Jun 28 (1). *Cowan & Darlington* 20 May 1929 (2b). *Cufodontis* 19 May 1929 (1). *Czerniaëw* 1853-1854 (1), 29 Jun 1853 (1), 31 May 1854 (2a), *Hylmö* 1980 (1). *Degen 10* (2a), *252* (1), *352* (1), *488* (1), *488B* (1), 16 Jun 1899 (1), 11 Jun 1900 (2a), 20 May 1916 (1), 21 May 1916 (1), 22 Jun 1916 (1). *Degen & Flatt 82* (2a). *Delarze 40284* (2a). *Dervtz* 16 Jun 1937 (2a), 26 Jun 1937 (2a). *Dessiatoff 2169* (3b), *2199* (3b). *Dieterle 1350* (3b). *Dimitrijin* May 94 (2a). *Dimonie Jul* 1908 (2a). *Döbbeler 241* (2a). *Doerfler 866* (1). *Doreff* 20 Jun

1894 (2a). *Drobov* 19 Apr 1906 (2b). *Drummond 23332* (4), *23344* (4). *Dubovik* 12 Jun 1957 (1). *Dufft* May 1845 (2a), 26 May1884 (2a). *Dulfer* Jun 1961 (2a). *Dunkel* 22 Jun 1991 (2b). *Duthie 13857* (4). *Duty* 6 Jun 1955 (2a), 4 Jul 1972 (2a). *Duval-Jouve* 3 Jul 1861 (2a). *Duvigneaud Jul* 1955 (2a). *Dvořak* 29 May 1971 (2a), 24 May 1972 (2a). *Dzen-Litovskaja 742a* (4), *482* (4). *Dzevanovsky 2* (1). *Eberhardt 7323* (3a), *7885* (3a), *8798* (3a), *9362* (3a). *Ecklon* 1808 (2a). *Edelberg 2034* (4). *Eggert* 3 Jun 1869 (2b). *Einsander* 25 May 1880 (2a). *Enden 102* (2b), *159* (4). *Endtmann* 10 Jul 1960 (2b), 11 Jun 1960 (2a), 20 Jun 1962 (2b), 18 Jul 1962 (2b), 25 Jun 1963 (2b), 15 Jun 1964 (2b), 19 Jun 1964 (2b). *Esetreppig* 28 Jul 1881 (2a). *Fayvush, Tamanyan, Oganesyan, Ter-Voskanyan & Vitek 04-0516* (2a). *Fedtschenko 49* (3a), 2 Aug 1897 (4), 27 Jul 1904 (3a). *Fedtschenko, Noskov, Bobrov & Monyushko 201* (2a). *Fetsch* 24 May 1889 (2a). *Folkenson* 16 May 1958 (2a). *Frame* 7 Jun 1905 (1). *Freiberg 105/6* (2a). *Freitag 1514* (3a). *Frey 414: (6)* (4). *Gabrielan* 27 May 1960 (2a). *Gailing* 21 May 193 (2a). *Ganeshin 374* (2a). *Geisenheyner* Jul 1877 (2a). *Gilbert 32* (4). *Gilli* 13 Jul 1951 (3a), 2 Jun 1950 (3a). *Goloskokov* 20 May 1953 (3c), 9 Jun 1953 (3c), 12 Jun 1953 (3c), 4 Jun 1955 (4), 6 May 1956 (3c). *Golubeva, Denisova, Nadezhina, Krasil'nikov, Semidel & Sokolov* 20 Jun 1959 (2a) 23 Jun 1959 (2a), 3 Jul 1959 (2b). *Golubkova 1221* (1). *Gordienko & Chilikina 473* (3b). *Gordyagin 1260* (2a). *Gorschkowa 119* (1). *Görz* 16 May 1909 (2a). *Grebner 198* (2a). *Grey-Wilson & Hewer 662* (3a). *Grigorjev 119* (3b), *303* (1). *Grolle* May 1953 (2a). *Gross* 18 Jun 1882 (2a), 26 Jun 1895 (2a), 1923 (2a). *Grubov 21* (2b), *422* (3b). *Grubov & Lybarskiy 282* (4). *Grudzinskaya* 23 May 1961 (2b). *Güemes & Bacchetta 2510* (1). *Gugnacka-Fiedor 195* (2a). *Gusev 5275 dublet* (3c), *5755* (3a). *Hackel 7383* (2a), May 1880 (2b). *Hadinec* 2 Jun 1990 (2b). *Hainfolz 399* (2a). *Handel-Mazzetti* 23 May 1898 (2a), 30 May 1898 (2a), 1 Jun 1902 (2a) Jun 1935 (2a). *Hartmann 2383* (4), *2384* (4). *Harver* 3 Jul 1923 (2a). *Hasslerot, T.E.* 8 Jun 1928 (2a). *Hasslerot, B.E.* 20 Jun 1950 (2a). *Haussknecht* May 1854 (1), 25 May 1874 (2a), Jun 1879 (2a), 6 Jun 1887 (2a), 15 Jun 1899 (2a). *Heiland* Jun 72 (2a). *Henil* 1965 (2a). *Hirth* 20 May 1897 (2a). *Höfer* 1 Jun 1860 (2a). *Holubey* Jun 1880 (2a). *Höpflinger* 29 May 1955 (2a). *Hora 2099* (1), 10 Jun 89 (1), 20 Jun 1984 (1). *Hosek 4-2002* (2a). *Houby* 6 Jun 1900 (2a). *Ikonnikov 5654* (4), *10562* (3a), *12499* (3b), *14026* (3a), *16537* (4). *Ikonnikov, Ladygina & Litvinova 7424* (4), *7538* (4), *8756* (4). *Ikonnikov & Litvinova 5099* (2b), *6517* (2b), *6616* (2b), *6747* (2b). *Ikonnikov, Litvinova & Gladkova 6100* (2b). *Ilić* 10 Jun 1932 (2a). *Iljin 40* (2a), *101* (2a). *Iljin & Grigorjev 137* (2a). IPSE 18 Jun 1963 (1). *Ivanova & Tonshina 704* (1), *836* (2a), *1193* (1). *Ivashin 1516* (2b). *Jachan 9* (2a). *Jakouschev* 26 May 1910 (1). *Janka* 1 Jun 1869 (2a), 5 jun 1868 (1), 30 Jun 1868 (1), 19 Jun 1877 (1). *Jávorka* 29 May 1928 (2a). *John* 1827 (2a). *Jorges* 6 Jun 87 (2a). *Junatov, Li Shi-in & Yuan' I-fan 505a* (3c), *530* (4), *1438* (4). *Junatov & Yuan' I-fan 1019* (3c), *1104* (2a). *Jurisic* 16 May 1931 (2a). *Kalheber 78-464* (1). *Kamelin, Dariymaa, Gambold, Budantzev & Gubanov 876* (2b). *Kameshkina 163* (3b). *Karamysheva, Sanchir & Sumerina 527* (2a). *Karelin & Kiriloff* 1841 (2a). *Kárpati* 26 May 1936 (1). *Kasatkin 255* (3c). *Kashmenskiy* 1906 (2b). *Kästner* 15 Jun 1997 (1). *Kazakov 94* (2a). *Kazakova* 16 Jun 1922 (1). *Kerstan 1197* (3b), *1509* (4). *Khokhryakov & Mazurenko* 8 Aug 1949 (1). *Kiev* 10-30 Jun 1905 (2a). *Kivenheimo* 10 Jul 1978 (1), 23 Jul 1978 (1). *Kleopow* 17 May 1926 (2b), 19 May 1930 (2b). *Klopotov* 8 Jun 1912 (2a). *Knorring 178* (2a), *341* (1), *467* (4), *684* (4). *Koch* 8 May 1934 (2a), 11 Jun 1935 (2a). *Koelz 6046* (3a), *6924* (4). *Koop* 27 May 1960 (2a). *Korb* 22 May 1913 (2a), 16 Jun 1922 (2b), 21 May 1923 (2a), 26 Jun 1923 (1), 23 May 1933 (2a), 17 Jun 1942 (2a), 6 Jun 1943 (1). *Korotkova 443* (2a), *541* (3b). *Korshinskiy 5644* (4), *5648* (3b), 1878-1887 (2b), 23 May 1889 (2a). *Koskinen* 27 Jun 1945 (1). *Kotukhov* 25 Jun 1970 (2a), 2 Jun 1976 (4), 3 Jul 1991 (2a), 12 Jun 1992 (3c), 20 Jul 1993 (3b), 11 Jul 1998 (3a). *Kozlovskiy 1347* (2a). *Kramer 4962* (2a). *Kramer & Westra 4117* (2a). *Krascheninnikov, H. 5203* (3c), *5345* (2a), *5345* (3c), *5354* (3c), *5903* (3c), 9 Jun 1914 (3c). *Krasheninnikov, I.M. 111* (1). *Krasnoborov & Pyatak* 28 Jun 1964 (2a). *Krassnow* 1886 (3c). *Krenberger* 3 Jul 1877 (2a). *Krendl* 11 Jun 1961 (2a), 21 Jul 1968 (2a), 7 Jun 1970 (2a), 12 May 1973 (2a), 5 Jul 1973 (2a), 5 May 1975 (2a), 11 May 1975 (2a), 30 May 1976 (2a), 23 Apr 1977 (2a), 5 Jul 1978 (2a), 10 Jul 1978 (2a), 31 May 1987 (2a). *Krist* 3 Jul 1938 (1). *Kronotov* 1912 (2a). *Krylov* 18 Jun 1892 (2a), 10 Jun 1912 (2a). *Krylova & Dervin* 4 Jun 1951 (1). *Kučerovskaia 697* (1), 8 Jul 1912 (2a). *Kugelberg* Jul 1865 (1). *Kukkonen 7263* (3b). *Kulshnova & Buturlina* 19 Jun 1957 (2a). *Kuminova & Luikova 5818* (2a). *Künz* 5 May 2000 (2a). *Kurganskaya & Udintseva 536* (3c), *565* (4), 6 Aug 1960 (4). *Kurlyushkin* 12 Jun 1939 (1), 4 Jul 1939 (1). *Kuznetsov 114* (2a), *430* (2a), *688* (2a), 3 Jun 1911 (2a). *Kuznetsova* 1 Jun 1954 (2a). *Kuznezow 310* (1). *Lachashvili 29* (1). *Ladygina 1200* (3a). *Ladygina,*

Ikonnikov & Litvinova 18219 (4). *Lagarski* 13 Jun 1886 (2a). *Lagerheim* 1843 (2a). *Lamonf & Thermé 44360* (2a). *Landauer 691* (2a). *Lang* 3 May 1964 (2a), 14 May 1989 (2a), 1 Jul 1991 (1). *Langerak & Den Haag 1545* (2a). *Larin & Musatowa 218* (2b). *Laudberg* Jul 1898 (1). *Laus* Jun 1930 (2b), Jun 1931 (2a), Jun 1933 (1), Jun 1934 (1), Jun 1935 (1), Jun 1935 (2b), Jun 1936 (2a), Jun 1938 (2b) Jul 1938 (1). *Lavrenko & Rodin 944* (3a). *Lemke 586* (2a). *Lenz* 1865 (2a). *Leute 50* May 1969 (2a). *Licht 941 b* (2a), *941 c* (2a). *Likendrath* May 1867 (2a). *Lindberg* 11 Aug 1939 (2a). *Lindemann* Jun 1866 (2a), 10 Jun 1873 (2a). *Lippert 20891* (1). *Lippert & Merxmüller 17331* (2a). *Lippold* 16 Jun 1975 (2a). *Lispky 2355* (4). *Litvinov 4902b* (1), 5 Jul 1914 (1), *Ljirft* 22 May 1897 (2a). *Loewenberg 1011/178* (2a). *Longberg* 29 Jun 1845 (2a). *Lovelius* 29 May 1973 (2b). *Lundberg* Jun 1897 (2a). *Lundqvist 16738* (2b). *Makonsky* 5 Jun 1858 (2a). *Maljtsev 376* (2a), *670* (2a), 8 Jun 1907 (2a). *Marchesetti* Jun 1869 (2a). *Marret* 104 (2a). *Mathesius* Jun-Jul (1), Jun-Jul (2). *Mayer* 29 May 1921 (2a). *Medina & al. 2591* (1). *Medvedev 63* (4). *Melzer* 10 Jun /15 Jul 1962 (1), 7 Jul 1962 (2a), 15 Jul 1962 (1), 24 Jun 1964 (2a), 9 Jun 1965 (2a), 18 Jun 1969 (2a). *Mertens* 18 Jul 42 (1). *Merxmüller & Angerer 33 321* (2a). *Merxmüller & Wiedmann* 8 Jun 1950 (2a), 23 May 1953 (2a). *Metlesics* 29 May 1961 (2b). *Meyer & Lippold* 20 Jun 1965 (1). *Meyer, F.K.* 15 Jul 1977 (1), 25 May 1995 (2a). *Meyer, K.* 11 May 1950 (2a). *Meyer & Manitz* 5 Jun 1966 (1), 20 Jun 1976 (1), 20 Jun 1976 (2a). *Michajlova & Popova 66* (4). *Michelson 1978* (3c). *Missbach* Jun 1912 (1), Jun 1912 (2a). *Moraldo* 15 Jun 1984 (1), 20 Jun 1984 (1). *Morariu* Jun 1965 (2a). *Mrkvicka 8437* (2a), *13645* (2a). *Müller 1873* (2a), Jul 1879 (2a), 25 May 1879 (2a). *Murbeck* 19 Aug 1889 (2a). *Negrean* 1 Jun 1969 (2a). *Nepli* 28 May 1943 (4), 1 Jun 1943 (3a), 4 Sep 1943 (4). *Neubauer 230a* (3a), *233* (3a), *294* (3a). *Neuman* Jul 1901 (2a). *Neumayer* 11 May 1932 (2a), 8 Jun 1935 (2a), 28-29 May 1939 (2a). *Ničić* 8 Jun 1886 (2a). *Nilsson* 8 Jun 1928 (2a), 4 Jul 1948 (2a). *Novichkova* 9 Jun 1965 (2a), 29 Jun 1965 (2a). *Nyárády 1430* (1). *Nydegger 43755* (2a). *Oberneder* 17 May 1924 (2a). *Oborny* 12 Jun 1884 (2a). *Oenicke* 23 May 1933 (2a). *Oertel* Jul 1861 (2a). *Otruba 165* (1). *Ovchinnikov & Afanasiev187* (3c), *218* (3b), *405* (3a), *842* (3a), *851* (3a), *1196* (3a), *1964* (3a), *2047* (4), *2094* (4). *Pachoskii* 9 May 1909 (2a), 18 Jul 1911 (2b). *Pallon 6813* (2a). *Pastor Fest 1111* (1). *Pavlov 79* (3c), *181* (3b), *535* (4). *Pazij 19* (2b). *Peshkova & Tarasova 2043* (2a). *Pichauer* Jun 1921 (1). *Pisopliczka* 25 May 1925 (2a). *Pobedimova 127* (2b), *5102* (2b). *Podjakova* 25 Jun 1930 (2a). *Podlech 8209* (2a), *28441* (2a), *30256* (3a). *Podpera* 28 May 1896 (2a), 1 May 1897 (2a), 9 May 1897 (2a), May 1898 (2a), Jun 1898 (2a), May 1899 (2a), Jun 1899 (2a), 12 May 1921 (1), 6 Jul 1926 (1). *Podpera & Jirásek 164* (2a), *165* (1). *Pokorny & Strudl* 31 May 1982 (2b), 8 Jun 1982 (2a), 20 May 1985 (2b), 29 May 1985 (2a), 14 Jul 1986 (1). *Poltawa* 25 May 1891 (2a). *Polyakov 324* (3b). *Potanin 87* (4). *Pralrow* Jul 1898 (2b). *Prenss May* 1910 (2a). *Prilipko & Vichert* 27 Jul 1931 (1). *Printz* Jun 1914 (2b). *Prodán* 14 Jun 1910 (2a). *Prokofieva 122* (2b). *Prokofiev & Agafanov* 10 Jun 1973 (2b). *Puolanne* 1918 (1). *Quelle* 13 May 1894 (1). *Raus & Pina Gata 24-1-4* (2b), *35-1-13* 2 Jun 1999 (2b). *Rechinger 17627* (3a), *32005* (3a), 13 May 1926 (2a). *Regel* 1838 (2a). *Regel* 15 Jul 1928 (1). *Rehmann 216* (2a). *Reinhard* 29 May 1854 (2b). *Reschikov* 14 Jul 1967 (2a). *Reverdatto* 25 May 6 Jul 1926 (2a), 25 Jun-6 Jul 1926 (2b). *Richter K.* 18 May 1833 (2a), 14 May 1871 (2a). R*ichter L. 313* (1), *312* (1), *312* (2a). *Rickmers-Bremen* 1928 (4), *Roborowski* 4 Jun 1893 (4). *Roessler 321* (2a), *2465* (2a), *6363* (2a). *Ronniger* 22 May 1913 (2a), 23 May 1926 (2a), 13 May 1928 (2a), 17 May 1928 (2a), 19 May 1929 (2b), 16 May 1932 (2a), 27 May 1936 (2a), 25 May 1941 (2a). *Roslyak* 17 Jun 1958 (1). *Rothmaler 19947* (2a), *20142* (2a), 30 May 1928 (2a). *Rozhevitz 644* (3c). *Rafiq & Hayat HG-97-102* (3a), *HG-97-368* (3a). *Rubtsov* 16 Jun 1929 (2b). *Ruppert* 30 May 1929 (2a). *Rusanov 167* (4). *Sahlnén* Jun 1872 (2a). *Sarycheva* 26 May 1956 (2a). *Savič & Sokolova 73* (4). *Schahel* 2 Jul 1975 (2a). *Schellauf* 15 Jun 1936 (2a). *Scheppig* 28 Jul 1881 (2b), 18 Jun 1882 (2a), 26 Jun 1895 (2a). *Schiffers 2138* (1), May 1885 (2a). *Schischkin* 30 Jul 1919 (1). *Schischkin, Steinberg & Sumnevicz* 29 May 1931 (4). *Schleiden* 1843 (2a). *Schlyters* 16 Jun 1879 (2a). *Schmarf* 28 Aug 1930 (1). *Schmid 128* (3a), *2335* (4). *Schneeweiß & Schönswetter 2211* (2a). *Schneider* 20 May 1923 (2a), 13 May 1938 (2a), 21 Jun 1960 (1), 29 Jun 1960 (2a), 14 Jun 1962 (2a), 26 May 1963 (2a), 30 May 1963 (1). *Schneller* May 1868 (2a). *Schneller* May 1868 (1), May 1868 (2a). *Schühe* 1957 (2a). *Schuhwerk 81/163* (2a), *86/140* (2a). *Schwarz* 30 May 1928 (2a), 20 May 1947 (2a). *Šestka 765* (2a). *Shischkin* 17 Jul 1934 (3c). *Shischkin & Genina* 26 Jun 1913 (3c). *Shulga* 1907 (2a). *Šída 4387* (2b) *Simonkai 3986* (2a), *3990* (1), 10 May 1878 (2a), 24 May 1894 (2a), 1 Jun 1904 (1). *Sishkin* 6 Jun 1914 (2a). *Sjoberg* 4 Aug 1890 (1). *Skvortsov* 17 Jun 1963 (1), 14 May 1970 (2b), 6-7 Jul 1979 (2a), 1 Jun 1985 (2a), 7 Jul 1993 (1). *Smidt*

387 (2a). *Smirnova 525* (2a), Jul 1931 (1). *Smirnow 4* (2a), *28* (2a), *29* (4), *32* (3c), *40* (1), *54* (2a), *101* (2a), *4902a* (1). *Sobolevskaya & Stennikova* 9 Jun 1946 (2a). *Sorger & Buchner 82-84-52* (2a). *Soška* May 1935 (2b). *Sosnowsky* 5 Jul 1925 (2a). *Spiridinow 294* (2b). *Spitsnes* May 1899 (2a). *Stainton 2806* (3a). *Stanyukovich, Sidorov, Krivonogova, Ladygina & Ikonnikov 1161* (4), *1172* (4), *1317* (4), *1634* (4), *1703* (4), *2176* (3a), *4632* (4). *Staudinger 98/4/8* (2a). *Stewart R.R. & Stewart I.D. 22201* (4). *Sticfelhagen 2412* (2a). *Strudl 145* (2b), 18 Jun 1984 (2a), 20 May 1985 (2b). *Stud. Biol. Rheno-Trai. in itinera 271* (2a), 17 Jul 1960 (2a), 27 May 1967 (2a). *Suhova 18* (2a). *Sultanov 238* (3a), *528* (4). *Suza* Jun 1911 (1). *Švestka 765* (2a). *Theurillat 4010* (2a). *Timmermans* Jul 1936 (2a). *Titov 614* (3c), *1144* (3c). *Tod 8753/4* (2a). *Tschech* Jun 1935 (2a). *Tulinow* 1901 (3b). *Tuturin & Bessedin 291* (3a). *Tzvelev 353* (2b), *1499* (3b), *1636* (3b), 17 Jun 1952 (4), 15 Jul 1952 (4). *Ullepitsch.* 6 Jul 1895 (2a), May 1909 (2a). *Vagina & Kovachevich* 28 Jun 1956 (2a). *Hoiaisluoma* 1964 (1). *Valina & Kovacevik* 15 Jul 1988 (2a). *Vallen* 10 Jun 02 (2a). *Vandakurova* 22 May 1949 (1). *Vandas* 27 Aug 1922 (1). *Vašak* 23 May 1974 (2a), 7 Jul 1975 (2a), 31 Jul 1975 (1), 29 Jul 1981 (2a). *Vasilevich et al. 70* (4). *Vasiliev & Korovkin 222* (2a). *Vautier* 21 May 1949 (2a). *Velenovsky* 1 Jun 1884 (2a), 30 Jul 1884 (1), 2 Aug 1884 (1), 1 Aug 1886 (1), 21 Jul 1887 (1). *Vestergren* 30 Jul 1922 (2a). *Vetter* 28 May 1905 (2b), 11 Jun 1911 (2a), 27 May 1912 (2b), 9 Jun 1922 (2b), 12 Jun 1912 (2a), 16 May 1913 (2a), 22 May 1913 (2a). *Vinogradova 61* (2b). *Vogel* 6 Jun 1921 (2a). *Vogeler* 8 Jul 62 (2a). *Voike* 21 May 1985 (1). *Volhman* 15 May 1910 (2a). *Volk 71/188* (3a), *71/211* (3a), *71/242* (3b), *71/369* (3a), *2251* (3b), *2773* (3b). *Wagner 958* (1), 1942 (1), Jun 1921 (1). *Walger* 14 May 1939 (2a). *Wallengren* Jul 1875 (1). *Walter 8175* (2b). *Weber 384* (1), 30 Jun 1931 (1), 20 May 1932 (1), Jun 1933 (2a), Jun 1935 (1), Jun 1936 (1). *Wettstein* 1908 (2a), May 1909 (2a), 21 May 1914 (2a). *Weyner* 4 Jun 1867 (2a). *Winter* 1865 (2a), 1867 (2a). *Wirtgen 596* (2a), Jun 1910 (2a). *Witasek* Apr 1904 (2a). *Wittmer* 10 May 1881 (2a). *Wolaszezak* 22 May 1913 (2a). *Wolf* May 1898 (2a). *Yanishevsky* 2 Jun 1904 (2b). *Yarmolenko & Gontscharow 1120* (3b). *Zaikan* 30 May 1913 (2a). *Zepnhaor* 1818 (2b). *Zermetti* 27 Jun 1937 (1). *Zerny* 17 May 1920 (2a). *Zetterstedt* 6 Jul 1871 (2a). *Zigmundik* 22 May 1915 (2a). *Zotterman* 29 May 1953 (2a). *Zvereva & Chesnokova* 2 Jul 1967 (2a).

APPENDIX 2. Variables used in the morphometric analysis.

Quantitative characters: GLL: Glumes length (cm); **LEML**: Lemma length (mm); **CAL**: Callus length (mm); **PERL**: Peripheral ring length **(mm); PERW**: peripheral ring width (mm); **PERL/PERW**: Ratio of peripheral ring length and peripheral ring width; **AWN**: Awn length (cm); **AWND**: Awn diameter (mm); **COL**: Column length (cm); **SET**: Seta length (cm); **COL/ SET**: Ratio column length and seta length; **LEMH**: Lemma hairs length (mm); **BASD:** Basal leaf-blade diameter (mm); **LL:** Basal ligule length (mm); **LUL:** Ligule uppermost leaf length (mm); **D_S:** Dorsal and subdorsal rows joining length (mm); **D_S /LEML:** Ratio Dorsal and subdorsal rows joining length and lemma length; **ML:** Ventral row length (mm); **DL:** Dorsal row length (mm); **DL/LEML:** Ratio dorsal row length and lemma length; **PH:** Plant height (cm). **Qualitative characters**: **ABIND:** Abaxial surface of basal blade-leaf: glabrous (0); minutely scabrous (1); distinctly scabrous (2); sparsely stiff hairs (3); **ADIND:** Adaxial surface of basal blade-leaf: scabrous (0); pubescent (1); papillose (2); minutely pubescent (3); **LBA:** Leaf-blades apex: glabrous or scabrous (0); finished in a tassel of hairs (1); long acuminate (2); **BLM:** Basal leaf ligule margin: glabrous (0); ciliate (1); ciliolate (2); **BLT:** ligule tip: glabrous (0); ciliate (1); ciliolate (2); **UPO:** Upper sheaths ornamentation: glabrous (0); papillose (1); scabrous (2); scabrous with stiff hairs (3); **CO:** Culm ornamentation: glabrous (0); scabrous (1); pubescent (2); **PA:** Panicles: exserted (0); partially enclosed (1); enclosed (2); **PBI:** Panicle basal internode surface: glabrous (0); scabrous (1); pubescent (2); **DSDF:** dorsal and subdorsal free: no (0); yes (1); **CS:** callus shape: slightly curved (0); straight (1); **ACS:** awns column surface: hairy (0); glabrous (1); tuberculate (2).

Capítulo 5. Revisión taxonómica de *Stipa* subsección *Pulcherrimae* (Poaceae). Taxonomic revision of *Stipa* subsection *Pulcherrimae* (Poaceae)

Resumen

Stipa subsección *Pulcherrimae* está formado por un total de 10 especies y 5 subespecies, distribuidos por Europa, Asia central, oeste de Asia y Norte de África. La subsección se caracteriza por tener una arista larga y plumosa, con la columna glabra o escábrida (raramente pelosa) y la seta con pelos mayores de 3,5 mm, lema con 6 o7 líneas de pelos, con la línea dorsal y subdorsales fusionados en la base o con la línea dorsal ausente, con la línea ventral llegando al ápice de la lema (raramente acabando antes del ápice), ápice de la hoja basal glabro o cortamente ciliada y ovario con dos estilos. Presentamos una revisión taxonómica basada en el estudio de 2453 especímenes procedentes de 35 herbarios. Para cada taxon se provee una descripción morfológica detallada, la distribución geográfica, mapas de distribución e ilustraciones, también se provee una clave dicotómica para su identificación. Los siguientes lectotipos se han propuesto *S. joannis* var. *eriosoma, S. rubens* prole *rubentiformis* y *S. villifolia.* Además se propone tres combinaciones nuevas: *S.* subsect. *Pulcherrimae* (Martinovský) R. Gonzalo, *S. austroitalica* subsp. *sicula* **(**Moraldo, Caputo, La Valva y Ricciardi) R. Gonzalo y *S. epilosa* subsp. *araxensis* (Grossh.) R. Gonzalo.

Taxonomic revision of *Stipa* subsection *Pulcherrimae* (Poaceae)

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***Abstract**: Stipa* subsection *Pulcherrimae* (Martinovský) R. Gonzalo consists of 10 species and 5 subspecies occurring in Europe, Central and West Asia, and North Africa. The subsection is defined by its long and plumose awn with the column glabrous or scabrous (rarely hairy) and the plumose awn with hairs longer than 3.5 mm, lemma with 7 or 6 rows of hairs, with the dorsal and subdorsal rows of hairs fused at the base or the dorsal row absent, the ventral row of hairs reaching the lemma apex (rarely ending before the lemma apex), basal leaf apex glabrous or shortly setaceous, and ovary with 2 styles. We present a taxonomic revision mostly based on the study of 2453 vouchers from 35 herbaria. We provide the geographical distribution with distributional maps, detailed morphometric description and illustration for the taxa, as well as a key for their identification. Lectotypes for *S. joannis* var. *eriosoma*, *S. rubens* prole *rubentiformis* and *S. villifolia* are here proposed. Likewise, three new combinations are proposed: *S.* subsection *Pulcherrimae* (Martinovský) R. Gonzalo, *S. austroitalica* subsp. *sicula* **(**Moraldo, Caputo, La Valva and Ricciardi) R. Gonzalo and *S. epilosa* subsp. *araxensis* (Grossh.) R. Gonzalo.

Keywords: Awn, Grass, Europe, *Stipeae*, taxonomy.

The genus *Stipa* is classified within the large and world spread tribe *Stipeae*. Its species are widely distributed in Europe, Asia and North Africa, inhabiting open communities, mainly rocky slopes and dry places of basic soils, from sea level to high mountain ranges (Tzvelev 1976; Romaschenko et al. 2007, 2010; Barkworth et al. 2008; Cialdella et al. 2010). Following the current taxonomic concept of *Stipa*, the genus is characterized by the spikelets with only one anthecium, glumes equalling or longer than the lemma, a deciduous or non deciduous apical awn, two or three lodicules (Clayton and Renvoize 1986) and a small chromosome complement based on $x = 10–12$ (Tzvelev 1976; Freitag 1985; Romaschenko et al. 2007, 2010). Over the course of its nomenclatural history, the genus *Stipa* has been split and lumped several times, according to the different interpretation of the morphological features. In the last century, 300–400 species of *Stipa* have been recognized, distributed throughout the temperate and subtropical regions of both hemispheres (Clayton and Renvoize 1986; Tzvelev 1976; Bor 1970; Cope 1982; Moraldo 1986; Freitag 1985; Watson and

Dallwitz, 1992). Presently, the generic boundaries have been modified and the species from America, Australia and partially Europe and Africa have been arranged in new or resurrected genera, for example: *Hesperostipa* (Elias) Barkworth, *Austrostipa* S.W.L. Jacobs and J. Everett, *Celtica* F.M. Vázquez and Barkworth, *Amelichloa* Arriaga and Barkworth, and *Pappostipa* (Speg.) Romasch., P.M. Peterson and Soreng. As a consequence, *Stipa* s.s. has been reduced to *c.* 140 species occurring in Asia, Europe, and North Africa (Romaschenko et al. 2007; Barkworth et al. 2008).

Among the *c.* 12 sections currently recognized within *Stipa*, one of the taxonomically most complex is sect. *Stipa*, which is represented by 14 species native to the temperate and alpine zones of Europe, Asia and infrequently in high mountain ranges of North Africa. Species of this section are diagnosed by a more or less caespitose habit, long acuminate glumes, lemma terete, with longitudinal rows of hairs, awn bigeniculate, column glabrous, smooth (rarely hairy), seta plumose with hairs longer than (3)4–6(6) mm long, ovary 2–styled (Martinovský 1977; Tzvelev 1976; Vázquez and Devesa 1996).

Species of section *Stipa* have been the subject of various and conflict taxonomic treatments (Martinovský 1982; Klokov and Osȳchnyuk 1976; Moraldo 1986). Taxonomy is complicated in sect. *Stipa* from the fact that (1) most of the species are distributed over a broad altitudinal range, exhibiting a high morphological variation, (2) there are only few morphological characters used to delimit taxa, most of them overlapping across recognized species, and (3) they have high chromosome numbers (2n= 32, 36, 44), indicating a very active speciation by polyploidy (Freitag 1985). As well as in other sections (*Smirnovia* Tzvelev, *Subsmirnovia* Tzvelev, *Subarbatae* Tzvelev, *Barbatae* A. Junge), these species have developed one of the most effective anemochorous diaspores (plumose awn), allowing genetic flow among populations resulting in the occurrence of numerous transitional forms (Freitag 1985). The lack of stable morphological structures and the difficulty of establishing clear morphological boundaries between the taxa, has promoted the creation of a high number of taxa at specific and infraspecific rank (Smirnow 1925, 1926, 1929, 1934, 1970; Martinovsky 1982; Klokov and Osȳchnyuk 1976; Moraldo 1985). The need to solve many of the taxonomic problems of the section was pointed out before by Tzvelev (1974, 1976), Scholz (1985), and Freitag (1985), which were forced to reduce the number of accepted species in *Stipa*.

Stipa sect. *Stipa* has been profusely investigated, but most of the taxonomic treatments have been partial or regional in scope (Bor 1968; Klokov and Osȳchnyuk 1976; Moraldo 1985; Freitag 1985; Scholz 1985; Vázquez and Devesa 1995). Only Martinovský (1982) and Tzvelev (1976) studied exhaustively the genus *Stipa*, including all the taxa from Europe and the former Soviet Union, respectively. However, the nomenclature and the taxonomy of this group are still confusing and misunderstanding (Freitag 1985).

Martinovský´s (1966, 1967, 1970, 1976, 1977, 1980, 1982) studies were mainly focused in the species of section *Stipa* from Europe. He recognized five series, five subseries and around 70 taxa in section *Stipa*, based mostly on the leaf ornamentation and the spikelets size. Series *Penicelliferae* (subsect. *Stipa*) and ser. *Tirsae* (=subsect.

Tirsae), have been revised by Gonzalo et al. (unpublished). Species of these series are characterized by having a tuft of hairs at the apex of the basal leaves (*S. pennata* L.) or a

MARTINOVSKÝ (1965, 1966, 1967, 1970, 1975, 1976), Europe	KLOKOV AND OSŸCHNYUK (1976), Ukraine only.	MORALDO (1986), Italy only.
Ser. *Pulcherrimae*	Sect. *Parastipa*	Ser. *Pulcherrima*
Subser. *Eriocaulis*	Ser. *Paradoxae*	Subser. *Eriocaulis*
Subser. *Atlanticae*	Ser. *Anomalae*	Subser. *Atlanticae*
Subser. *Epilosae*	Sect. *Stipa*	Subser. *Epilosae*
Subser. *Syresitschikovianae*	Ser. *Dasyphyllae*	Subser. *Syresitschikovianae*
Ser. *Tirsae*	Ser. *Atlanticae*	Ser. *Siculae*
Ser. *Dasyphyllae*	Ser. *Eriocaulis*	Ser. *Barbatae*
Ser. *Penicilliferae*	Ser. *Pulcherrimae*	
Subser. *Penicilliferae*	Ser. *Poëticae*	
Ser. *Lessingianae*	Ser. *Rubentes*	
	Ser. *Penniciliferae*	
	Ser. *Stenophyllae*	

Table 1. Subdivision of *Stipa* sect. *Stipa*.

long setaceous apex (*S. tirsa* Steven), lemma with the marginal row of hairs ending below the apex and with the dorsal row quite longer than the subdorsal ones. Series *Lessingianae* Martinovský only includes the widespread *S. lessingiana* Trin. and Rupr., a native species from South and East Europe, Caucasus and Asia. Series *Lessingianae* is characterized by having the lemma completely hairy and the ligules of basal leaves very short (Martinovský 1976). More recently, Tzvelev (1993) included *S. lessingiana* in sect. *Subarbatae* Tzvelev based on the previous characters in addition to the glabrous column, seta with short hairs (< 3 mm long), lemma 9–12 mm long and 2 styled ovaries.

Series *Pulcherrimae* Martinovský, has been recognized as the largest group in the section, including *c.* 60 species native to Europe, Caucasus, Asia and North Africa (Martinovský 1982; Moraldo 1986; Tzvelev 1976 1986, 2006; Vázquez and Devesa 1996; Vázquez and Gutiérrez 2011). This group can be identified by the combination of the dorsal row of the lemma shorter than the subdorsal row, or absent (rarely slightly shorter than the subdorsal row), together with the ventral row of hairs reaching the top (rarely ending 1–2 mm below the apex). Martinovský (1966, 1967, 1977), divided the series into 4 subseries, based on the presence of hairs in the column and the ornamentation of the basal leaf. Eight species with a hairy column were included in subser. *Syresitschikovianae* Martinovský. The remainder species were segregated, based on the ornamentation of the adaxial surface of the basal leaf, as follows: subser. *Atlanticae* Martinovský (pubescent), subser. *Epilosae* Martinovský (scabrous, tuberculate or papillae), subser. *Eriocaulis* Martinovský (scabrous ribs and shortly pubescent furrows). Finally, ser. *Dasyphyllae* Martinovský included those species with the abaxial surface of the basal leaf–blades bearing soft or stiff hairs. Other treatments

of sect. *Stipa* (Klokov and Osȳchnyuk 1976; Moraldo 1986) have proposed new series (Table 1), but have been regional in scope.

Series *Pulcherrimae* and *Dasyphyllae* are reduced here to subsection *Pulcherrimae* (Martinovský) R. Gonzalo. The diversity of this group has provided the description of an intriguing number of taxa, based on the floral size and the basal leaf ornamentation. This same diversity has resulted in a highly confused and complicated classification with knotty keys. Many of the problems arise from the low number of characters available to delimit taxa, most of them overlapping across recognized species, and the high phenotypic plasticity of some taxa. The study of abundant material has shown that there are many transitional forms between narrowly delimited species. This study is part of an ongoing comprehensive taxonomic treatment of *Stipa* sect. *Stipa*, whose purpose is revaluating the classification of subsect. *Pulcherrimae* based on the examination of herbarium specimens from throughout the range of the group. Of the *c.* 60 taxa recognized for subsect. *Pulcherrimae* by Martinovský (1982), Moraldo (1986), and Klokov and Osȳchnyuk (1976) we have reduced the number of taxa to 10 species and 5 subspecies because, in our opinion, the fine distinction between many of those taxa cannot be supported.

MATERIAL AND METHODS

This revision is based on the study of 2453 specimens (Appendix 1) from the following herbaria: B, BOLO, BR, C, COI, E, FI, G, GDA, GH, GOET, H, HBG, JACA, JE, K, L, LD, LE, M, MA, MEL, MPU, NY, PAL, PR, S, SEV, U, UNEX, UPS, W, WAG and WU. Digital photographs from FI, LE and BUCA also have been examined.

All characters used to distinguish taxa in former studies of *Stipa* L. (Tzvelev, 1976; Klokov and Osȳchnyuk 1976; Martinovský 1982; Moraldo 1986; Freitag 1985; Vázquez and Devesa 1996) were checked with herbarium material to assess their taxonomic value. Additional characters were also analyzed according to our observations. For this study, 70 quantitative characters on 452 herbarium specimens were recorded and measured using a Mitutoyo CD–15CD digital calliper (Tokyo, Japan). Vouchers and specimens were selected to cover the highest morphological variation found, as well as to contain the whole set of organs corresponding to the selected characters. The measurements on the spikelets were performed on the distal spikelets of the second most apical axis of their panicle, and on the longest branch. The length of the basal leaf–blade was measured from the second leaf and the width at 2 cm from the ligule; likewise, the width of the awn was taken at 5 mm from the base. For all characters, exploratory analyses, including descriptive statistics for quantitative ones and box plots, were performed using the Statistic (http://www.statsoft.com) package to elaborate detailed morphological descriptions for each recognized taxon based on both, quantitative and qualitative data. Additional data related to the habitat, distribution and chromosome number were based on the literature and information on the collection labels. Also the distribution data were used to build detailed distribution maps, with the program ArcView GIS v. 3.2. for Windows.

Transverse sections of basal leaves were obtained with a Bright Starlet 2212 Cryostat, stained with Fasga mixture (Tolivia and Tolivia 1987) and photographed under optical microscopy. Idiograms of these were drawn by J. L. Castillo.

TAXONOMIC CHARACTERS

HABIT

Species of *Stipa* subsect. *Pulcherrimae* are perennial and herbaceous plants. All the taxa are more or less xerophilous, exhibiting intravaginal growth, with many vegetative shoots and few generative shoots, resulting in more or less caespitose and tufted habits, referred to as a "Rosulate perennial growth form" by Freitag (1985).

VEGETATIVE BODY

Culms are straight and 2–4 noded and almost covered by the culm leaf–sheaths. Culm nodes are glabrous. The ornamentation of the culm highly varies in the same species, and even in the same individual it can be different in upper and lower nodes. Besides, the ornamentation of the culm is different below the nodes and on the rest of its surface, being *e.g.* pubescent below the node and minutely pubescent, papillae or glabrous on the rest (*e.g. S. pulcherrima* Koch, *S. atlantica* P.A. Smirn.).

LEAVES

Leaf ornamentation is highly variable within subsect. *Pulcherrimae,* depending whether it is the basal leaf or the culm leaf. Likewise, the surface ornamentation varies along the length of the leaf and its age. Traditionally, the leaf ornamentation is used for the differentiation of closely related taxa and several taxa have been described in base this character.

LEAF–SHEATHS

Besides the difference between the basal and culm leaf, the ornamentation can also vary within species and at different development stages. The basal leaf–sheaths are glabrous in young leaves and minutely pubescent in developed ones (*e.g. S. eriocaulis Borbás*, *S. dasyphylla*). Other species usually share completely glabrous sheaths (*S. pulcherrima*), while others could exhibit independently glabrous, somewhat scabrous or minutely pubescent sheaths (*S. zalesskii* Wilensky). The upper sheaths surface differs depending on the distance to the leaf–blade and to the leaf–sheath margins. Thus, many of the species are pubescent, scabrous or papillae close to the leaf–blade and next to the margins, while the rest is glabrous. The basal leaves can be ciliate or with glabrous margins, while the culm leaf–sheaths usually have the margins glabrous.

LEAF–BLADES

Most of the species are primarily xerophytic, exhibiting convolute or involute leaf–blades and more rarely flat. In general, leaf features are extremely variable within species, especially in the widespread taxa. Despite this variability, leaf–blades ornamentation has been profusely used for taxa delimitation, and several taxa have been described mainly based on this character. In the present work, blades have been thoroughly examined, being particularly useful the combination of trichome type, length and distribution pattern in both sides, together with geographical and ecological patterns. The leaf–blade ornamentation is very constant in *S. dasyphylla* (Czern. ex

Lindem.) Trautv., with basal leaf–blades covered by long soft hairs. However, in the remainder taxa of the subsection the leaf ornamentation highly varies. *Stipa atlantica* is the most variable species, with the basal leaf–blade abaxial surface scabrous and more rarely glabrous or hairy at the base and the adaxial surface scabrous, scattered pilose, or densely pubescent.

Likewise, the ornamentation of the culm leaves can agree with the basal leaf, and has been useful to distinguished closely related taxa. For example: *Stipa eriocaulis* present the adaxial surface of the basal leaf with scabrous or papillae ribs and furrows minutely pubescent, whereas the culm leaf could be densely pubescent or have the same ornamentation as the basal leaf. Although, the basal leaf ornamentation is not so clear in young specimens, which have the adaxial surface of the basal leave scabrous and could be misidentified with *S. epilosa*. In this case, is the culm leaf which allows the recognition of *S.eriocaulis*, which has the adaxial surface of the culm leaf totally pubescent or with scabrous ribs and furrows minutely pubescent, whereas *S. epilosa* has the adaxial surface of the culm leaf scabrous as well as the basal leaf.

Histology of the leaf–blades of sect. *Stipa* has been profusely studied (Martinovský 1970, 1977, 1980; Connert 1982; Devesa 1992). Species of subsect. *Pulcherrimae* are C3–grasses (XyMS+), with leaf–blades bearing adaxial ribs or "nodular" in transverse section (Watson and Dallwitz 1992) and mesophyll with non–radiate chlorenchyma. The abaxial surface of leaf–blades has a regular outline, whereas the adaxial one is divided into conspicuous ribs of unequal size, separated by deep and narrow furrows with V or U shapes (Figs. 2, 7, 10, 4d, 12c). The number of ribs ranges from 7 to 13, in relation to the width of the leaf–blades. Apices of the ribs may be rounded or quadrangular (Figs. 2, 7, 10). Bulliform cells are displayed in discrete fan–shaped groups of three to five cells at the base of the furrows and they are usually small and inconspicuous. Vascular bundles are more or less embedded in the middle of the mesophyll, and its number is correlated with the number of ribs. Two different kinds of vascular bundles are found, which typically alternate one with another (Figs. 2, 7, 10, 4d, 12c). Each rib corresponds to one vascular bundle of the "basic type" (Metcalfe 1960), accompanied by sclerenchyma girders reaching both sides of the leaf–blades (Figs. 2, 7, 10, 4d, 12c) or only the abaxial side when the ribs are less developed (Fig. 2, 7, 10, 4d, 12c). Usually, each furrow displays, alternating with the ribs, a small bundle without girders or with these only joined to the abaxial surface. The xerophilous nature of the species of these two sections is reflected in the presence of continuous subepidermical layers of sclerenchyma connecting the abaxial girders to each another.

LIGULES

In subsect. *Pulcherrimae*, ligules are highly variable in shape, size, margin and ornamentation. Ligules are rounded, truncate, obtuse, acute or irregular, and ranging from glabrous to highly pubescent, with the margins usually ciliate. Moreover, the characters of the basal leave ligules differ from those of the culm leaves. The extremely variability of the ligules, especially within species, drastically limits its taxonomic utility.

INFLORESCENCES

The inflorescence is more or less contracted, paniculate, with patent to patent–spreading branches, and usually bearing few spikelets. The panicle is usually exerted or partially enclosed by the upper leaf–sheath depending on the developmental stage of the inflorescence. The first internode can be pubescent or scabrous, but with no relevance for the taxa delimitation.

GLUMES

Each spikelet has only one floret, without rachilla extension, and enclosed by two membranous, equal or subequal glumes. The glumes are long acuminate, 3–9 nerved, with the midrib reaching the top and the others ending gradually towards the top. The glumes are usually scabrous in *S. pulcherrima* and in *S. dasyphylla*, while the other species show smooth glumes. The midrib could be indistinctly ciliate in most of the species, being of less importance for species recognition. When measuring the glumes in *Stipa*, it is important to take into account that the tips are very delicate and break easily.

ANTHECIUM

For practical reasons, the anthecium consists of lemma, palea and callus. Although the awn is part of the lemma, for convenience is not included in the length of the anthecium (Freitag, 1985). The anthecium is coriaceous with overlapping margins, enclosing the flower and the caryopsis. All the structures enclosed by the anthecium: anthers, lodicules and ovary, are of low taxonomic value in the subsection and awkward to be observed.

LEMMA

The size and ornamentation of the lemma together with the basal leaf ornamentation have been traditionally used for the delimitation of several taxa. Commonly, the subsection shows indistinctly 6 or 7 rows of hairs, but in *S. eriocaulis* subsp. *eriocaulis* the dorsal row is usually absent, exhibiting 6 rows. The ventral and lateral rows are distinct, whereas the dorsal and subdorsal ones are fused. The subsection is characterized by having the ventral row reaching the top of the lemma. However, there are few subspecies were the ventral row ends before reaching the top (*S. eriocaulis* subsp. *lutetiana* Scholz, *S. zalesskii* subsp. *ucrainica* (P.A. Smirn.) Tzvelev, *S. austroitali*ca subsp. *sicula* (Moraldo, Caputo, La Valva and Ricciardi) R. Gonzalo). The lemma apex is glabrous, sometimes surpassed by two small extension of the lemma called tips appearing indistinctly in the different species of the subsections. These tips are quite longer in *S. austroitalica* var. *appendiculata* (Celak.) Martinovský.

CALLUS

The callus is the tie point with the glumes. It is cylindrical and hidden by antrorse hairs. The lowermost part is acute, pungent, oblique and curved, comprising the scar surrounded by the peripheral ring (Freitag, 1985). The scar shape is elliptic or slightly circular.

PALEA

The palea is enclosed by the lemma and their lengths are relatively similar. The palea is usually glabrous, rarely with a row of hairs between the two nerves. Likewise, the apex could by indistinctly ciliate.

LODICULES

The number of lodicules is three, one contiguous to the palea (ventral) and two flanking the dorsal side of the mature caryopsis (dorsal). The dorsal lodicules are lanceolate, while the ventral is lanceolate or linear–lanceolate, and slightly longer or shorter than the dorsal ones. The dorsal lodicules occasionally show ciliate apex, but without diagnostic value.

AWN

The awn is divided in two parts, column and seta (also called bristle). The column is the basal part of the awn, which is bent twice. Towards the first bent the column is glabrous or scabrous, rarely hairy. Forms with hairy columns have been described as new subspecies or species. However, more convincing is the interpretation of Scholz (1985), upheld by Freitag (1985), who considered these specimens as temporary aberrant forms or mutants. Between the first and second bent, the ornamentation can be glabrous, scabrous or with scattered hairs. The seta is always flexuous and plumose, with hairs usually longer than 4 mm long. The length of the awn is highly variable in most of the species but it has been used as a taxonomical character in combination with others.

STAMENS

There are 3 equal stamens per anthecium, whose size varies in proportion to the lemma length. The absence or presence of hairs at the apex occurs within the same species, and in consequence stamens do not provide useful diagnostic characters.

OVARY AND CARYOPSIS

Ovaries are similar in all the species, glabrous and with 2 styles. The mature caryopsis is fusiform, with a linear hilum that almost reaches up the top, and whose size varies in proportion to the lemma length.

TAXONOMIC TREATMENT

STIPA SUBSECT. **PULCHERRIMAE (**MARTINOVSKÝ) R. GONZALO COMB. NOV.

Basion.: *Stipa* ser. *Pulcherrimae* Martinovský, Webbia 20: 718. 1965. *Type: S. pulcherrima C. Koch*

Subseries *Atlanticae* Martinovský, Feddes. Repert. 73: 150. 1966. *Stipa* subser. *Atlanticae* Martinovský, Preslia 39: 272. 1967. nom. illeg. *Stipa* ser. *Atlanticae* (Martinovský) Klokov, Novosti. Sist. Vyssh. Nizsh. Rast. 1975: 23. 1976. *Type: S. syreistschikowii* P.A. Smirn.

Series *Dasyphyllae* Martinovský, Preslia 47: 260. 1975; *Stipa* ser. *Dasyphyllae* Martinovský Preslia 48: 186. 1976. nom. illeg. *Type: S. dasyphylla* Cern.

Subseries *Eriocaulis* Martinovský, Preslia 39: 272. 1967; *Stipa* ser. *Eriocaulis* Klokov, Novosti. Sist. Vyssh. Nizsh. Rast. 1975: 39. 1976. *Type: S. eriocaulis* Borbás

Subseries *Epilosae* Martinovský, Preslia 39: 272. 1967. *Type: S. epilosa* Martinovský

Series *Poeticae* Klokov, Novosti. Sist. Vyssh. Nizsh. Rast. 1975: 56. 1976. *Type: S. poetica* Klokov.

Series *Rubentes* Klokov, Novosti. Sist. Vyssh. Nizsh. Rast. 1975: 64. 1976. *Type: S. rubentiformis* P.A. Smirn.
Series *Siculae* Moraldo, Webbia 40: 211. 1986. *Type: S. sicula* Moraldo, Caputo, La Valva and Ricciardi)
Subseries *Syresitschikovianae* Martinovský, Preslia 49: 100. 1977. *Type: S. syresitschikovii* P.A. Smirn.
Stipa sect. *Parastipa* Klokov, Novosti. Sist. Vyssh. Nizsh. Rast. 1975: 23. 1976. nom prov., nom inval. *Type: Stipa syreistschikowii* P.A. Smirn. p.p.
Stipa ser. *Paradoxa* Klokov, Novosti. Sist. Vyssh. Nizsh. Rast. 1975: 23. 1976. *Type: Stipa syreistschikowii* P.A. Smirn.

Herbs densely caespitose, perennial; branching intravaginal. Culms 2–3(4) noded, patent. Basal leaves convolute; abaxial surface glabrous, scabrous, minutely scabrous at the base and the remainder glabrous, hirsute, pubescent or scabrous with scattered stiff hairs; adaxial surface somewhat scabrous, scabrous with scattered hairs, papillae, pubescent, minutely pubescent and with scattered long hairs or with furrows minutely pubescent and the apex ribs scabrous; ligules acute, obtuse or rounded, glabrous, scabrous or pubescent, margins glabrous, ciliate or ciliolate. Panicle contracted, 3–5(6) noded, the first internode glabrous, scabrous or pubescent; branches patent, setaceous or minutely setaceous. Glumes equal or subequal, lanceolate, long acuminate, 3–9 nerved and with the central nerve distinctly ciliate. Anthecium coriaceous, fusiform or laterally compressed; lemma with 7 rows of hairs with the dorsal and subdorsal rows of hairs fused at the base and the dorsal row shorter or slightly longer than the dorsal row or with 6 rows of hairs with the dorsal hair absent, the ventral rows of hairs reaching the lemma apex (rarely ending before the lemma apex); callus acute, curved or straight, villous, scar elliptic, peripheral ring dorsally flattened and protruding; palea lanceolate, two–nerved and equalling or slightly shorter than the lemma; lodicules 3, equal or subequal, acute, membranous, lanceolate or linear–lanceolate. Awn bigeniculate; column glabrous or minutely scabrous (rarely pilose); seta flexuous and plumose, hairs > 3.5 mm long. Ovary glabrous, styles two.

Notes: Subsection *Pulcherrimae* is easily distinguished by its long and plumose awn with the column glabrous or scabrous (rarely hairy) and the plumose awn with hairs longer than 3.5 mm, lemma with 6 or 7 rows of hairs, the dorsal row and the subdorsal rows of hairs fused at the base or the dorsal row absent, the ventral row of hairs reaching the lemma apex (rarely ending below); the basal leaf apex glabrous or shortly setaceous, ovary with 2 styles. Species of subsect. *Pulcherrimae* occur in steppes, rocky slopes and open communities from lowlands to alpine habitats, usually being the dominant element. Members of subsect. *Pulcherrimae* are widely distributed through the Atlas range of North Africa, Europe, Caucasus, Asia and South Siberia.

Many species have broad distribution often combined with high morphological variation. The size of the spikelets structure and the basal leaves ornamentation highly varies contributing to the high number of taxa described. The ornamentation of the basal leaves often varies without recognizable cause, but in some causes the pubescent is constant and a useless character for taxa delimitation (*S. dasyphylla*). Species of subsect.

Pulcherrima are fairly similar to each other and can overlap in range. This situation has resulted in a high number of synonym and uncertainty about the circumscription of the species.

In Martinovský's (1966, 1967, 1970, 1976, 1977, 1980, 1982) treatment of the group, *S. pulcherrima* was split into 15 species and many subspecies. Moreover, he described two series and 4 subseries (Table 1), mostly based on the basal leaf ornamentation. On the contrary, Freitag´s (1985) monograph of *Stipa* from Southwest and West Asia, treat the species of *Stipa pennata*–complex (sect. *Stipa s.s.*) in a broad sense, recognizing only three species (*S. pennata, S. turkestanica* Hack. and *S. tirsa*) and giving subspecies rank to the most coherent populations. The species concept in the present work is intermediate between both points of view. We have search for consistent morphological differences, together with geographical distributions and habitats.

The present treatment expands the circumscription of ser. *Pulcherrimae*; species such as *S. dasyphylla* and *S. zalesskii*, placed by Martinovský in ser. *Dasyphyllae*, are here included in subsect. *Pulcherrimae*. In the present work 10 species are accepted, reducing the number of previously described by Martinovský and recognizing others considered within the variation of *S. pennata* (Freitag, 1985, Strid 1991)

KEY TO THE SPECIES AND SUBSPECIES

1. Basal leaf–blade abaxial surface hairy 2
1. Basal leaf–blade abaxial surface scabrous or glabrous 6
2. Basal leaf–blade abaxial surface covered by rigid hairs, rough to the touch 3
2. Basal leaf–blade abaxial surface covered by soft hairs, smooth to the touch. 4
3. Ventral lemma row reaching or almost reaching the lemma apex .....
.....1a. *S. zalesskii* subsp. *zalesskii*
3. Ventral lemma row ending (1.75)1.9–4.8(5.1) mm below the lemma apex.....
.....1b. *S. zalesskii* subsp. *ucrainica*
4. Totally of the basal leaves–blade covered by hairs and more than half of the leaf length covered by soft hairs up to 1 mm long ..... 2. *S. dasyphylla*
4. Only some basal leaves–blade with hairs or leaves–blade with less than half of the leaf length covered by hairs up to 0.4 mm long 5
5. Basal leaf–blade (0.34)0.41–0.66(0.73) mm in diameter, adaxial surface pubescent, scabrous, with small conical papillae, or scabrous with long hairs 0.1–0.52(0.6) mm long..... 3. *S. atlantica*
5. Basal leaf–blade (0.4)0.5–0.96(1.1) mm in diameter, adaxial surface with scabrous or papillae ribs and furrows minutely pubescent with hairs (0.05)0.07–0.15 mm long .....
..... 6a. *S. pulcherrima* subsp. *pulcherrima*
6. Leaves–blade adaxial surface totally scabrous by prickles or papillae 7
6. Leaves–blade adaxial surface scabrous with sparsely long hairs, or not scabrous.....11
7. Basal leaf–blade abaxial surface glabrous or minutely scabrous at the base 8
7. Basal leaf–blade abaxial surface distinctly scabrous.....9
8. Basal leaves green; anthecium (15)15.8–20(21.7) mm long.....
.....4a. *S. epilosa* subsp. *epilosa*

8. Basal leaves pruinose, covered by a blue cloak; anthecium 20.3–24 mm long .....
.....4b. *S. epilosa* subsp. *araxensis*
9. Glumes (4.2)6.5–9.05(11) cm long; anthecium (16)18.9–23(25) mm long; awn column (6)6.4–9.6(10.7) cm long 10
9. Glumes (3.9)4.3–5.7(6.2) cm long; anthecium (14.5)14.9–18(18.3) mm long; awn column (3.8)4.1–5.6(6.1) cm long.....5. *S. novakii*
10. Glumes glabrous; basal leaf–blade (0.34)0.41–0.66(0.73) mm in diameter .....
..... 3. *S. atlantica*
10. Glumes scabrous at least at the base; basal leaf–blade 0.5–0.9(1) mm in diameter.....
.....6b. *S. pulcherrima* subsp. *crassiculmis*
11. Basal leaf–blade adaxial surface with scabrous or papillae ribs and furrows minutely pubescent 12
11. Basal leaf–blade adaxial surface totally pubescent, scabrous, or scabrous with sparsely long hairs 15
12. Basal leaf–sheath pubescent, basal leaf–blade abaxial surface glabrous or minutely scabrous and the basal leaf ligule usually pubescent.....13
12. Basal leaf–sheath glabrous or only pubescent near the blade, basal leaf–blade abaxial surface scabrous or distinctly scabrous and the basal leaf ligule usually glabrous or scabrous..... 6a. *S. pulcherrima* subsp. *pulcherrima*
13. Lemma (18)18.9–23.2(23.6) mm long; column (5.2)6.2–8.6(9) cm long, between first and second geniculation scabrous with scattered long hairs..... 8. *S. dasyvaginata*
13. Lemma (14.1)15.5–19.8(21.2) mm long; column (3.2)4.9–7.3(8.9) cm long, between first and second geniculation, glabrous, scabrous, rarely with scattered long hairs.....14
14. Ventral lemma row reaching or almost reaching the apex .....
.....7a. *S. eriocaulis* subsp. *eriocaulis*
14. Ventral lemma row ending (1.9)2.3–5 mm long below the apex.....
..... 7b. *S. eriocaulis* subsp. *lutetiana*
15. Basal leaf–blade abaxial surface distinctly scabrous.....16
15. Basal leaf–blade abaxial surface, glabrous or minutely scabrous at the base 20
16. Basal leaf–blade adaxial surface scabrous with sparsely long hairs, abaxial surface usually scabrous by prickles.....17
16. Basal leaf–blade adaxial surface densely pubescent, abaxial surface usually scabrous by prickles or scabrous by prickles mixed with stiff hairs 19
17. Glumes (4.2)6.5–9.05(11) cm long; anthecium (16)18.9–23(25) mm long; awn column (6)6.4–9.6(10.7) cm long 18
17. Glumes (3.9)4.3–5.7(6.2) cm long; anthecium (14.5)14.9–18(18.3) mm long; awn column (3.8)4.1–5.6(6.1) cm long.....5. *S. novakiii*
18. Glumes glabrous; basal leaf–blade (0.34)0.41–0.66(0.73)..... 3. *S. atlantica*
18. Glumes scabrous at least at the base; basal leaf–blade 0.5–0.9(1).....
.....6b. *S. pulcherrima* subsp. *crassiculmis*
19. Basal leaf–blade abaxial surface scabrous by small prickles; culm ligules scabrous or glabrous ..... 3. *S. atlantica*
19. Basal leaf–blade abaxial surface scabrous, with a mixture of prickles and stiff hairs (rarely only prickles); culm ligules pubescent or scabrous .....

.....1a. *S. zalesskii* subsp. *zalesskii*
20. Basal leaf–blade adaxial surface with small hairs in the furrows and ribs scabrous with sparsely long hairs or totally pubescent; seta (14.5)16.2–27.3(29) cm long.....21
20. Basal leaf blade–adaxial surface totally scabrous with sparsely long hairs; seta (12.4)13.4–20.5 cm long cm long ..... 10. *S. endotricha*
21. Lemma ventral row almost reaching the apex .....
....9a. *S. austroitalica* subsp. *austroitalica*
21. Lemma ventral row ending 1.7–7.3 mm before the apex .....
.....9b. *S. austrotialica* subsp. *sicula*

1. *Stipa zalesskii Wilensky*

Stipa zalesskii Wilensky, Dnevn. Vserossisk. Sezda Russk. Bot. 1: 41. 1921, nom. nud.; *Stipa pennata* subsp. *zalesskii* (Wilensky) Freitag, Notes Roy. Bot. Gard. Edinburgh 42: 443. 1985. *Type*: RUSSIA. Near Saratov, slopes in Kalubanov distr, 5 Jun 1918, *Zalesskij s.n.* (lectotype, LE! designated by Tzvelev, 1976).

Herbs 24–63 cm high, perennial, caespitose; branching intravaginal. Culms 2–3 noded, nodes glabrous, violet; culm internodes pubescent, scabrous or glabrous. Basal leaves 18–62 cm long, green and occasionally pruinose; leaf–sheath minutely pubescent, glabrous or papillae, glabrous or ciliate, cilia 0.12–0.6 mm long; leaf–blades 15–56 cm long, (0.3)0.4–0.6 mm in diameter, convolute, abaxial surface distinctly scabrous by prickles and stiff hairs or scabrous with sparse stiff hairs (rarely only distinctly scabrous by prickles), hairs (0.1)0.3–0.6(0.9) mm long, adaxial surface pubescent or scabrous with sparse long hairs, hairs (0.08)0.3–0.7(0.86) mm long; ligules (0.32)0.85–2.6(4.1) cm long, obtuse, rounded, acute or lanceolate, scabrous (rarely glabrous or minutely pubescent), ciliate or ciliolate (rarely glabrous). Floriferous culm leaves 25–60 cm long; leaf–sheath 21–47 cm long, scabrous with scattered hairs near the leaf–blade and margins and the remainder glabrous, papillae or completely scabrous or papillae, margins usually glabrous; leaf–blade 2–18 cm long, (0.12)0.24–0.52(0.72) mm in diameter, abaxial surface scabrous or with sparsely stiff hairs, adaxial face pubescent (minutely pubescent with sparsely hairs), hairs (0.06)0.15–0.45(0.7) mm long; ligules (0.45)2.4–6(8) mm long, acute, lanceolate or rounded, usually scabrous or glabrous, margins and tip usually glabrous or ciliolate, cilia 0.01–0.05 mm long. Panicle 15–50 cm long, contracted, exserted by the upper leaf–sheath, 2–4(5) noded; basal internode (6)11–29(39) cm long, pubescent (rarely scabrous); branches (0.9)1.4–3.7(4.4) cm long, patent or ascending, setaceous, setae (0.04)0.2–1(1.7) mm long; basal nodes with (1)2 branches with 1(2) spikelets each. Glumes subequal, lanceolate, long acuminate, glabrous or ciliate on the central nerves, cilia (0.1)0.2–1.3(1.6) mm long, green with purple stains, margins and tip hyaline, the lower (4.8)5.2–8.1(9.1) cm long and 3–5(6) nerved, the upper (4.3)5–7.8(8.4) cm long and 5–(7)8 nerved. Anthecium (15.7)16.5–21.4(23.1) mm long, (0.7)0.9–1.3(1.64) mm wide, fusiform, coriaceous, green, brown or pale brown; lemma (9.8)12.8–16.3(18) mm long, near the apex glabrous, with 7 or 6 rows of hairs, with the dorsal and subdorsal ones fused and the remainder rows free, the

ventral row reaching the top or ending (0.3)1.88–4.8(5.1) mm below the top, the dorsal row measuring 1/2–1/4 the length of the lemma (rarely absent), the remainder rows slightly shorter or longer than dorsal row, lemma with patent hairs (0.3)0.5–0.9(1.1) mm long; apex glabrous; callus (2.9)3.2–5.4(6.5) mm long, acute, curved, villous, hairs (1.5)1.7–2.6(2.9) mm long on the ventral face and (0.9)1.1–1.7(1.9) mm long on the dorsal face, scar elliptic, peripheral ring 0.81.1(1.2) mm long, (0.24)0.27–0.38(0.57) mm wide (ratio wide/length= (0.27)0.3–0.42(0.48)); palea (11.4)12.3–15.8(16.8) mm long, lanceolate, margins and tip hyaline, dorsally 2–nerved, between the two nerves papillae or glabrous, margins glabrous and tip glabrous or ciliate, rarely with a dorsal row of hairs up to 1/4 the length of the palea, pale, brown or green; lodicules 3, equal or subequal, with the dorsal ones slightly longer or shorter than the ventral one, acute, lanceolate or linear lanceolate, membranous, glabrous, dorsal lodicules (1.8)2.2–3.3(3.7) mm long, ventral lodicule (1.7)1.9–3.3(4.2) mm long. Awn (21)27–42(51) cm long, bigeniculate; column (2.9)4.5–7(8.2) cm long, base (0.45)0.5–0.7(0.74) mm in diameter, twisted, brown, brown and green and frequently with purple stains, glabrous, tuberculate or scabrous (rarely pilose); geniculation (1.4)1.5–2.7(3.4) cm long, glabrous, scabrous (rarely with scattered hairs); seta (15)20–33(41) cm long, (ratio column length/seta length = (0.17)0.25–0.37(0.44)), flexuous, plumose, hairs in lower part (3.8)4.2–5.5(6.1) mm long. Anthers (5.3)6.7–9.4(10.3) mm long, glabrous (rarely with scattered hairs), yellow or purple. Ovary glabrous, styles two. Caryopsis (8.5)8.8–12.1(12.4) mm long, fusiform; embryo (1.3)1.6–2.5(2.6) mm long.

1a. Stipa zalesskii subsp. zalesskii

Stipa canescens P.A. Smirn. ex Roshev. in Kom. (ed.), Fl. URSS 2: 741. 1934; *Stipa zalesskii* subsp. *canescens* (P.A. Smirn. ex Roshev.) Tzvelev, Novosti Sist. Vyssh. Rast. 11: 17. 1974. *Type*: ARMENIA. Nor–Bajazet distr., in viciniis pag. Elenovka, 2 Jul 1929, *Zedelmeier and Geideman s.n.* (holotype, LE!).
Stipa iljinii Roshev., Izv. Bot. Sada AN SSSR 30: 294. 1932; *Stipa zalesskii* var. *iljinii* (Roshev.) Tzvelev, Novosti Sist. Vyssh. Rast. 11: 18. 1974. *Type:* KAZAKHSTAN. Semi–palatinsk coast, environs of village Znamenskoe, 6 Jul 1928, *Iljin and Heinrichson 387* (holotype, LE!).
Stipa maeotica Klokov and Ossyeznjuk, Novosti Sist. Vyssh. Nizsh. Rast. 1975: 60. 1976; *Stipa zalesskii* var. *maeotica* (Klokov and Ossyeznjuk) Tzvelev, Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol. 91(1): 121. 1986; *Stipa zalesskii* subsp. *maeotica* (Klokov and Ossyeznjuk) F.M. Vázquez and M. Gutierrez, Telopea 13: 164. 2011. *Type:* UKRAINE. Donetsk Region, Budenov District, reserve “Khomutovskaya steppe”, 11 May 1955, *Grynj s.n.* (holotype, KW; isotype, LE!).
Stipa setulossima Klokov and Ossyeznjuk, Novosti Sist. Vyssh. Nizsh. Rast. 1975: 33. 1976; *Stipa majalis* var. *setulossima* (Klokov and Ossyeznjuk) Tzvelev, Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol. 91(1): 121; *Stipa majalis* subsp. *setulossima*

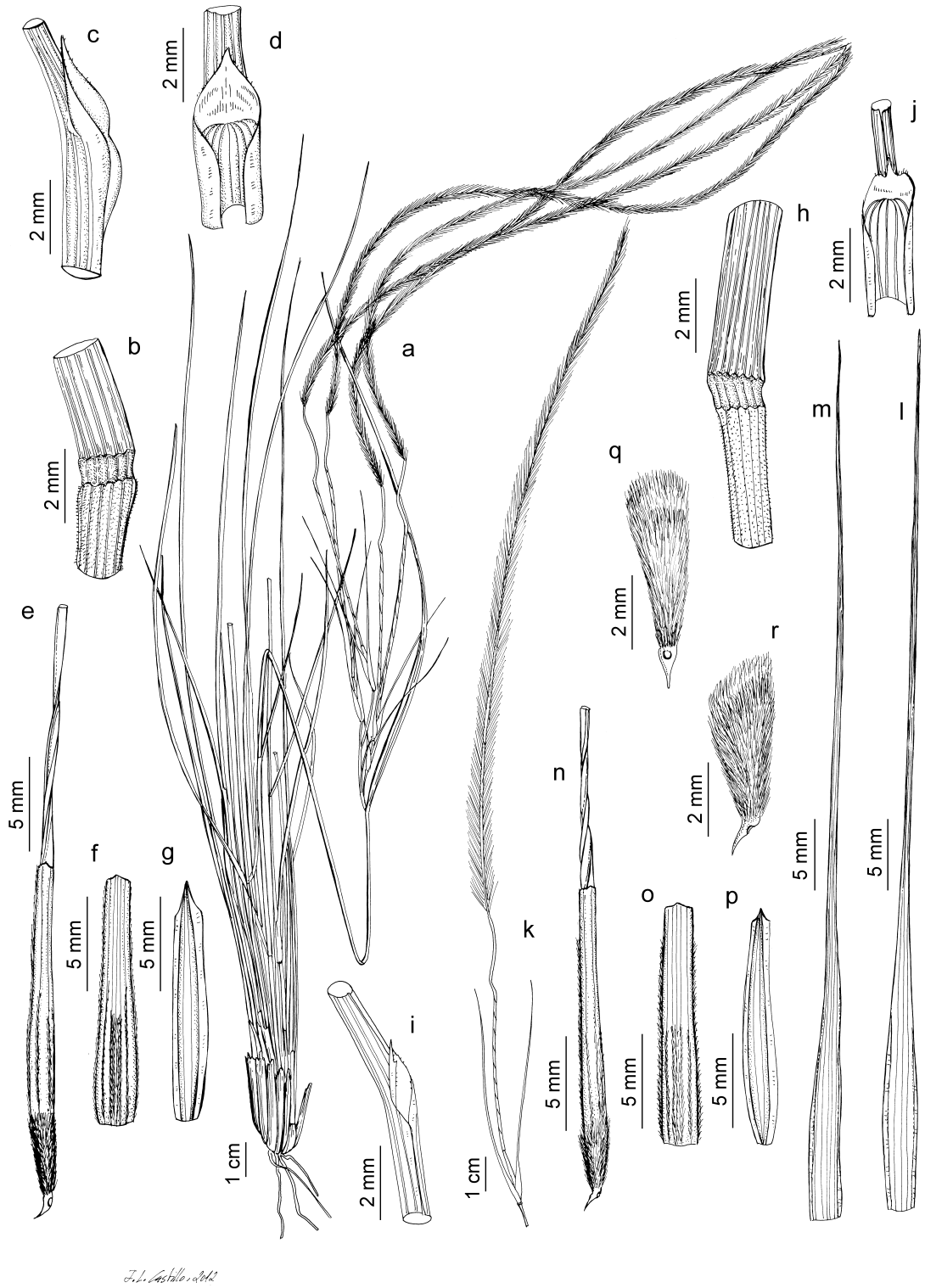

Figure 1. *Stipa zalesskii* subsp. *zalesskii*. A, habit; B, floriferous culm node; C, ligule, lateral view; D, ligule, frontal view; E, anthecium and column; F, lemma; G, palea. *Stipa zalesskii* subsp. *ucrainica*. H, floriferous culm node; I, ligule, lateral view; J, ligule, frontal view; K, spikelet; L, upper glume; M, lower glume; N, anthecium and column; O, lemma; P, palea; Q, callus, ventral view; R, callus, lateral view. [Based on: A–G, *Nikitin* 23 May 1975 (MA); H–R, *Skvortsov* 13 May 1970 (M)].

F.M. Vázquez and M. Gutierrez, Telopea 13: 159. 2011. *Type:* UKRAINE. Odessa Region, Kominterovskiy District, village Pershotravnevoe, 19 May 1973, *Krytzka s.n.* (holotype KW; isotype LE!).
Stipa majalis Klokov and Ossyeznjuk, Novosti Sist. Vyssh. Nizsh. Rast. 1975: 33. 1976; *Type:* UKRAINE. Odessa Region, Kominterovskiy District, village Pershotravnevoe, 19 May 1973, *Krytzka s.n.* (holotype KW; isotype LE!).
Stipa pontica P.A. Smirn., Repert. Spec. Nov. Regni Veg. 26: 268. 1929; *Stipa pontica* (P.A. Smirn.) Hayek, Prodr. Fl. Penins. Balcan. 3: 349. 1932, comb. superfl.; *Stipa zalesskii* subsp. *pontica* (P.A. Smirn.) Tzvelev, Novosti Sist. Vyssh. Rast. 11: 17. 1974. *Type:* TURKEY. In veneis ad Amasia, 20 Jun 1890, *Bornmüller 2577* (holotype, LE; isotypes B!, E!, JE!, G!, Z!).
Stipa turcomanica P.A. Smirn., Repert. Spec. Nov. Regni Veg. 21: 234. 1925; *Stipa zalesskii* subsp. *turcomanica* (P.A. Smirn.) Tzvelev, Novosti Sist. Vyssh. Rast. 11: 18. 1964. *Type:* TURKMENISTAN. Turcomania, in montibus pr. Ash(kh)abad, distr. Karakalinsk, 9 May 1897, *Litinov 177* (holotype, MW; isotypes LE!, E!, JE!, W!).
Stipa rubens prole *glabrata* P.A. Smirn., Trudy Glavn. Bot. Sada 40: 115 1928; *Stipa zalesskii* var. *glabrata* (P.A. Smirn.) Tzvelev, Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol. 91: 120. 1986; *Stipa glabrata* (P.A. Smirn.) Tzvelev, Maevskii, Fl. Sredn. Po. Evrop. Ch. SSSR, ed. 9: 809. 1964; *Stipa zalesskii* subsp. *glabrata* (PA Smirn.) F.M. Vázquez and M. Gutierrez, Telopea 13: 164. 2011 *Type:* RUSSIA. Sergachskii post in Nizhegorod province, between Endovishchi and Krasnyi Yar, 17 Jun 1926. *P.A. Smirnow s.n.* (lectotype, LE designated by Tzvelev 1976).
Stipa rubens P.A. Smirn., Repert. Spec. Nov. Regni Veg. 21: 231 (1925); *Stipa zalesskii* var. *rubens* (P.A. Smirn.) Tzvelev, Novosti Sist. Vyssh. Rast. 11: 19 (1974). *Type:* Kazakhstan. Akmolinsk district and post, 11 versts east of Akmolinsk, 27 May 1914, *Ganeshin 351* (holotype, LE).
Stipa rubens prole *rubentiformis* P.A. Smirn., Trudy Glavn. Bot. Sada 40: 115 1928; *Stipa rubens* subsp. *rubentiformis* (P.A. Smirn.) F.M. Vázquez and M. Gutierrez, Telopea 13: 164. 2011. *Type:* RUSSIA. Saratov, near village Polivanovka, 1 Jun 1927, *Fedchenko, B.A. and Bobrov 30* (lectotype LE!, designated here).
Stipa smirnovii Martinovský, Preslia 47: 260. 1975. *Type:* CZECH REPUBLIC. Bohemia, bor.–occ. Montges České středohoří: in stepposis ad declivem austro occ. Collies Raná, Jun 1974, *Martinovský s.n.* (holotype, PRC, digital image!).

Herbs 25–63 cm high. Basal leaf–blade 18–55 cm long, (0.31)0.38–0.46(0.62) mm in diameter, abaxial surface distinctly scabrous by prickles and stiff hairs or scabrous with sparsely stiff hairs (rarely only distinctly scabrous by prickles), adaxial surface pubescent or scabrous with sparsely long hairs; ligule (0.3)0.8–2.7(4.1) mm long. Floriferous culm leaf–blade 2–18 cm long, abaxial surface scabrous or with sparsely stiff hairs, adaxial face pubescent (minutely pubescent with sparsely hairs). Glumes (4.3)5.2–8.1(9.1) cm long. Anthecium (15.7)16.4–21.7(23.1) mm long, (0.7)0.9–1.3(1.6) mm in diameter. Lemma (9.8)12.9–16.9(18) mm long, with 7 or 6 rows of hairs, with the dorsal and subdorsal ones fused and the remainder rows free, the ventral row reaching the top, the dorsal row measuring 1/2–1/4 the length of the lemma

(rarely absent), the remainder rows slightly shorter or longer than dorsal row. Awn (21)26–44(51) cm long; column (3.9)4.5–7(8.2) cm long, (0.45)0.52–0.7(0.74) mm in diameter; seta (15)20–34(42) cm long, plumose with hairs (3.8)4.25.5(6.1) mm long. (Fig. 1 a–g; 2 b_1, b_3, b_4)

Chromosome Number: Unknown.

Habitat and Distribution: A common component on stony steppes, rocky slopes (calcareous or limestone) and eventually in open forest, from sea level up to the high mountain belt at 3000 m. From East Europe (scattered found in Romania and Bulgaria and especially plentiful in Ukraine) through Caucasus, Turkey and European part of Russia to central and western Siberia. In Asia occurs in the Kopet Dagh Mountains of Iran and Turkmenistan, in western and Central Kazakhstan and sporadically found in the western part of Mongolia (Uvs) and China (Xinxiang). Also described from Central Europe (Czech Republic), but unfortunately no material has been studied. (Fig. 3)

Phenology: Flowers and fruits from May to August.

Representative Specimens Examined: ARMENIA. Armavir: Ararat District, the north–eastern slope of mountain Ketuz, 16 km to the north of Dashtakar village, 40° 11′ N 44° 8′ E, 15 Jun 1977, *Torosian s.n.* (W). Gegharkunik: Sevan, 40° 39′ N 44° 53′ E, n.d., *Polianska s.n.* (G); Pr. Pambak, 40° 23′ N 45° 32′ E, 20 Jun 2005, *Aedo et al. 11825* (MA); Chambarak district, NE of Lake Sevan, Artanish peninsula 2,5 km ESE village Shordzha, 40° 30′ N 45° 18′ E, 15 Jun 2002, *Fayvush et al. Optima Iter XI 0584* (M). Shirak: Amasia District, the vicinity of village Ibish, 40° 59′ N 43° 39′ E, 2 Jul 1979, *Fayvush, s.n.* (W); Agin Region, 40° 35′ N 43° 45′ E, 27 Jul 1939, *Oganesm s.n.* (LE); Amasia District, Oksyuz, 41° 7′ N 43° 40′ E, 9 Jul 1978, *Fayvush and Talanyan s.n.* (W). Tavush: Ad lacum Sevan, prope pag. Schordsha, 40° 30′ N 45° 29′ E, 28 Jul 1929, *Smirnow 95* (H, JE, S, W); Agmaganskiy Range, village Dzhatgdan at 2.5 km NE from Bezaklyu village, 40° 15′ N 44° 59′ E, 16 Jul 1929, *Magakjai 177* (S). AZERBAIYAN. Lankaran: Near the village Belaya Dara, 38° 55′ N 48° 55′ E, 13 Jul 1931, *Matveeva 576* (W). BULGARIA. Dobrich: Northen costal area of Black Sea, 10 km NW of Sabla, 5 km NE of Vidna, Gioren place, 43° 34′ N 28° 24′ E, 6 Jun 1999, *Raus and Pina Gata 44–1–1* (MA). CHINA. Xinxiang: Border Dzungaria. Range Dzhair. Pass Dzhair on the road from Toli to Otu, 45° 50′ N 84° E, 9 Aug 1957, *Junatov and Yuan' I–fan 1300* (LE). GEORGIA. Sagaradjo District. Iori plateau. David Garedji, 41° 28′ N 45° 17′ E, 16 May 2005, *Lachashvili 29* (NY). IRAN. Azerbayjan–E–Gharel: Berdesin Valley, 37° 39′ N 45° 14′ E, 20 May 1929, *Cowan and Darlington s.n.* (K). Mazandaran: North of Golestan Natioanl Park, ca. 8 km NW of Soolegerd begining of Nekarbandi valley, 37° 29′ N 56° 4′ E, Jun, *Akhani 10577* (M). Golestān: North Gonbad: 4 km S of Golidagh by roadside, 37° 38′ N 55° 56′ E, 26 May 1976, *Hewer 3877* (W). KAZAKHSTAN. Aktobe: Alatau transiliensis: Djolbulak, in valle fl. Kebin majoris, 51° 13′ N 57° 21′ E, 16 Jun 1896, *Brotherus s.n.* (H). Almaty: Dzharkentskii District, Sary–Dzhas station, 42° 12′ N 79° 2′ E, 27 Jun 1910, *Michelson 1635* (S); Semirechensk Region, Dzharkent uezd: mountains Karatau, rivers Kuru–kul'dek–Sumbe, 43° 5′ N 80° 25′ E, Jul 1910, *Michelson 1978* (WU); Semirechenskaya Province, Dzharkentskii District. Dzhalaul'tau, 44° 15′ N 79° 45′ E, 22 Jun 1910, *Michelson 1471* (G); Mugodzhary. The western slopes of Lzhaman–Chau, 48° 50′ N 58° 10′ E, 30 May 1927, *Ruslanov 261* (LE). East Kazakhstan: Semipalatinsk Region, Pavlodar uezd (administrative unit). The vicinity of village Krest'yanskiy, 52° 25′ N 77° 30′ E, 31 May 1914, *Kucherovskaya 63* (LE, S); Near River Kokpetinka. Semipalatinsk Region, the southern part of Semipalatinsk district. The tops of the middle part of mountain Chingiz, 48° 40′ N 79° 15′ E, 29 Apr 1914, *Shipchinskiy 431* (WU). Karaganda: Reg. Semiretschensk: distr. Dsharkent, in montibus Ak–tasty, 48° 36′ N 71° 19′ E, 22 Jun 1911, *Kasatkin s.n.* (G, M, NY, S); Kzyl–Ordynskiy Region. The middle part of Karsakpay District. Headwater of river Ul'kun Dzhizon–Kingir, 10 km to the south of village Ulutavskiy, 48° 39′ N 67° 0′ E, 11 Jul 1929, *Schipczinsky 277* (NY); 90 km to the south–west of the village Karaganda, town Karatoky, 49° 47′ N 73° 5′ E, 31 May 1965, *Vasilevich, Karamysheva and Rachkovskaya 2066* (G, M). MONGOLIA Uvs: Under–Hangai district. The northern macro–slope of Han–Huhei, 32 km to the south–east of Barun–Turun district, 49° 15′ N 94° 21′ E, 24 Jul 1973, *Banzrych*

et al. 5006 (LE). ROMANIA. Constanta: Hagiene, distr. Constanta, 43° 47′ N 28° 28′ E, 19 Jun 1967, *Negrean s.n.* (S). RUSSIA. Altai: In declivibus stepposis meridionalibus, pr. pag. Katon–Karagaj, 49° 10′ N 85° 36′ E, 2 Jul 1930, *Smirnow 5* (JE). Bashkortostan: Former Khakas Region. Chebakovskiy District. Mountain Malinovaya against the street Sarat, 54° 4′ N 59° 2′ E, 24–26 Jun 1931, *Golubintseva et al. s.n.* (NY). Khakassia: Siberia centralis: Minusinsk dstr. Kojbalskaja steppe. Inter pag. Letnik et Novo–Kurskaja, 53° 12′ N 91° 49′ E, 18 Jun 1927, *Reverdatto s.n.* (NY). Kurganskaya: Vargashinskiy District. Trans–Ural pilot station, ravine "Mayorskaya steppe", 55° 25′ N 65° 46′ E, 19 Aug 1928, *Ivanova 1886a* (LE); Between villages Pimenovka and Chesnokovka, 55° 20′ N 64° 54′ E, 22 Jun 1928, *Ivanova and Tonshina 105* (LE). Mordovia: Ruzaevskiy District. 3 km to the north of village Palaevka, 54° 3′ N 44° 57′ E, 23 Jun 1984, *Tihomirov et al. s.n.* (B). Novosibirisk: Zdvinsk District. The vicinity of the village Svetloye, 54° 29′ N 78° 17′ E, 8 Jun 1948, *Vandakurova and Vagina s.n.* (JE). Oremburg: Steppum stipaceum ad flum. Burtya, 51° 13′ N 57° 21′ E, 8 Jun 1931, *Chomutova s.n.* (E, G, H, JE, S). Rostov: Novotscherkassk, 47° 25′ N 40° 5′ E, 26 May 1910, *Jakouschev s.n.* (JE). Volgograd: Lake El'ton, near Karpov village behind the mountain Ulagan, 49° 16′ N 46° 35′ E, 6 Jun 1925, *Iljin and Grigorjev 260* (S); 90 km to the north of Volgograd and to the north of the village Olenii, 49° 32′ N 29° E, 4 Jun 1967, *Yunatov s.n.* (LE). TURKEY. Agri: E side of Tahir pass, 19 Km from Eleskirt to Horasan, 39° 50′ N 42° 33′ E, 24 Jul 1966, *Davis 47106* (K); 2 Km SW Caldiran, 39° 8′ N 43° 54′ E, 7 Jul 1982, *Melzer s.n.* (W). Erzincan: Kemah, around Maksutusagi Koy, 39° 37′ N 39° 11′ E, n.d., *Yildirimli s.n.* (G). Edirne: Iskenderköy, 10 km ESE Edirne, 41° 37′ N 26° 40′ E, 20 May 1902, *Bauer, Fitz and Spitzenberger 3102* (W). Erzurum: Carretera para Erzum (nº 925–04), 8 km antes do Porto Gölyurt, 40° 22′ N 40° 47′ E, 29 Jun 2001, *Sara Nisa et al. 982* (MA). Eskişehir: (Strabe: O. Hamidiye –14 – Gökcekaya, 63) c. 500 m S. Mamure köyü an der Strasse Alpu– Hamidiye Steppe, 39° 42′ N 31° 19′ E, 2 Jun 1969, *Buttler 13284* (M). Igdir: Grand Ararat, 39° 41′ N 44° 18′ E, 11 Aug 1910, *Robert 2114* (G). Kayseri: Prov. Kayseri/Malatya: W side of pass between Pinarbasi and Curum, 38° 43′ N 36° 23′ E, 18 Jun 1954, *Davis 21980* (G). Nevsehir: Zelve–Ürgüp, 38° 40′ N 34° 53′ E, 23 May 1989, *Bamps 8823* (BR). Van: 6 km NE Caldiran, 39° 10′ N 43° 52′ E, 7 Jul 1982, *Sorger and Buchner 82–46–14* (W); 36 km W Baskale, 38° 5′ N 44° 21′ E, 7 Jul 1982, *Sorger and Buchner 81–35–31* (W). TURKMENSITAN. Ahal: Kopet–dag, plateau to the west of Nukhur, 38° 29′ N 57° 1′ E, 24 Jun 1925, *Fedtschenko, Massagetov and Bobrov 674* (LE); Kopet–dag, Gaudan, Asupama Mountain, 37° 37′ N 58° 24′ E, 2 Jun 1925, *Fedtschenko, Massagetov and Bobrov 72* (LE); Ascent to the top Chapan–dag. Shiak–Maydan. On the slope of mountain Dushak, 37° 57′ N 57° 54′ E, 24 Jul 1928, *Fedtschenko and Bobrov 849* (LE); Bakhardenskiy district, on the slopes of the mountains 2 km to the west of Arvaz, 38° 14′ N 57° 9′ E, 14 Jun 1966, *Chopanov s.n.* (LE); Transcaspian region, Ashkhabad uezd, Gaudan post road. Slopes of Kopet–dag near Kurt–su. Matted slope, 37° 37′ N 58° 24′ E, 29 Apr 1916, *Drobow s.n.* (LE). Balkan: In montis Ashabad, 37° 57′ N 58° 22′ E, 9 May 1897, *Litvinov s.n.* (B, JE, M); Krasnovodsk Region, Karakalinskiy District. The South–Western Kopet–dag, Watershed plateau Kesse–Yol, 38° 20′ N 56° 30′ E, 23 May 1975, *Nikitin s.n.* (MA); Central Kopet–dag, Kheirabad, ravine near Dalancha, 37° 52′ N 57° 49′ E, 13 Jul 1954, *Medvedeva s.n.* (LE); Transcaspian region, Krasnovodskiy uezd, Karakalinskoe distr., eastern slope of mountain Syunt, 38° 31′ N 56° 24′ E, 8 May 1912, *Lipsky s.n.* (LE); Kargila on the way to Nukhur, 38° 29′ N 57° 1′ E, 28 May 1912, *Samokish s.n.* (LE); Kopet–dag, border post Chaek, 38° 29′ N 57° 1′ E, 26 Apr 1912, *Mikhaeva, A. 2168* (LE). UKRAINE. Kherson: Chongar peninsula, Island Kunk–Tyun, 46° 1′ N 34° 29′ E, 22 May 1969, *Kotov s.n.* (W). Krym: Southern coastal range "Yaila", near village of Novopaulovka, 22 km from Simferopol, 44° 57′ N 34° 6′ E, 30 May 1981, *Elias, Crow and Newcombe 5746* (NY); Vicinity of Sevastopol, Cape Phiolent, Kamyshovaya Bay, mountain Sapun–gora, 44° 33′ N 33° 34′ E, 16 May 1984, *Tzvelev et al. 493* (LE); Kerch District. Mountain Opuk, 45° 2′ N 36° 13′ E, 25 Jul 1955, *Dzevanovsky s.n.* (LE); The vicinity of Belogorsk, 45° 3′ N 34° 35′ E, 19 Apr 1958, *Kotov and Omelchyuk s.n.* (W); Tauria, distr. Lenino (olim Sem Koloderei), promonterium Kazantip, 45° 27′ N 35° 52′ E, 1 Jun 1977, *Belianina s.n.* (H).

1b. Stipa zalesskii subsp. ucrainica (P.A. Smirn.) Tzvelev

Stipa zalesskii subsp. *ucrainica* (P.A. Smirn.) Tzvelev, Novosti Sist. Vyssh. Rast. 11: 17. 1974; *Stipa ucrainica* P.A. Smirn., Feddes Repert. 26: 268. 1929. *Type:* UKRAINE. "Ekaterinoslavsk province, Alexandrovskii post, near Mirgorodovka farm house, steppe slope of Ternovaya ravine, *Alekhin 209* (holotype, MW).
Stipa joannis var. *dobrogensis* Prod., Consp. Fl. Dobr. 1: 9. 1934; *Stipa dobrogensis* Prod., Fl. Rom. ed. 2: 64. 1939; *Stipa dasyphylla* var. *dobrogensis* (Prod.) Borzá, Consp. Fl. Roman.: 29. 1947. *Type*: ROMANIA. Murfatlar, *Grintescu s.n.*; Murfatlar *Borza s.n.* (syntypes, BUCA).
Stipa krascheninnikovii Roshev., Mat. Komiss. Eksped. Issl. Akad. Nauk, ser. Kazakhst. 5: 253. 1928. *Type*: KAZAKHSTAN. Aktyubinsk district. Khobda basin, slope toward Tamde, 7 Jul 1926, *Illin and Avranchik 297* (lectotype, LE!, designated by Tzvelev 1976)
Stipa poetica Klokov, Novosti Sist. Vyssh. Nizsh. Rast. 1975: 57. 1976. *Type*: UKRAINE. Tauria, distr. Theodosianus, Planerskoje (Koktebel), Voloshinii mountain, 2 Jun 1965, *Klokov s.n.* (holotype, KW)

Herbs 25–56 cm high. Basal blade–leaf 25–62 cm long, (0.3)0.33–0.5 mm in diameter, abaxial surface distinctly scabrous by prickles and stiff hairs or scabrous with sparsely stiff hairs (rarely only distinctly scabrous by prickles), adaxial surface pubescent or scabrous with sparsely long hairs; ligule (0.8)1–2(2.8) mm long. Floriferous culm leaf–blade 3–12 cm long, abaxial surface scabrous or with sparsely stiff hairs, adaxial face pubescent (minutely pubescent with sparsely hairs). Glumes 5–7.4(8) cm long. Anthecium (16.2)16.518.7(20.7) mm long, (0.85)0.88–1.24(1.32) mm in diameter. Lemma (12.6)12.7–16(16.6) mm long, with 7 or 6 rows of hairs, with the dorsal and subdorsal ones fused and the remainder rows free, the ventral row ending (0.3)1.88–4.8(5.1) mm below the top, the dorsal row measuring 1/2–1/4 the length of the lemma (rarely absent), the remainder rows slightly shorter or longer than dorsal row. Awn 28–38 cm long; column (2.9)4.8–6.5(6.9) cm long, (0.46)0.5–0.7 mm in diameter; seta (21.3)23–30 cm long, plumose with hairs (4)4.1–5.9(6) mm long. (Fig. 1 h–r; Fig. 2 b_2)

Chromosome Number: 2*n*= 44, Freitag 1985; Tzvelev 1976.

Habitat and Distribution: Inhabits steppes and stony slopes from sea level up to middle mountains belt. 0–2300 m. *Stipa zalesskii* subsp. *ucrainica* is especially abundant at South and East Ukraine and the European part of Russia. More sporadically found in Armenia, Kazakhstan (Aral–Caspian) and the coastal area of the Black sea of Bulgaria. (Fig. 3).

Phenology: Flowers and fruits from May to July.

Representative Specimens Examined: ARMENIA. Tavush: distr. Krasnoselskoie, montes Areguni in vicinitate pagi Tokludza, 40° 20´ N 45° 36´ E, 31 Jul 1975, *Vašak s.n.* (B). BULGARIA. Burgas: East Stara Planini Mt. 20 km NNE of Burgas, NE of Kableshkovo, hill Bibernata, 42° 40´ N 27° 34´ E, 26 May 1999, *Raus and Pina Gata 20–1–11* (W). Dobrich: Southern costal area of Black Sea, 10 km NW of Sabla, 5 km NE of Vidna, Gioron place, 43° 34´ N 28° 24´ E, 6 Jun 1999, *Raus and Pina Gata 30–1–18* (W). KAZAKHSTAN. Aktobe: Aktyubinsk province. Between rivers Uil and Emba. Valley of

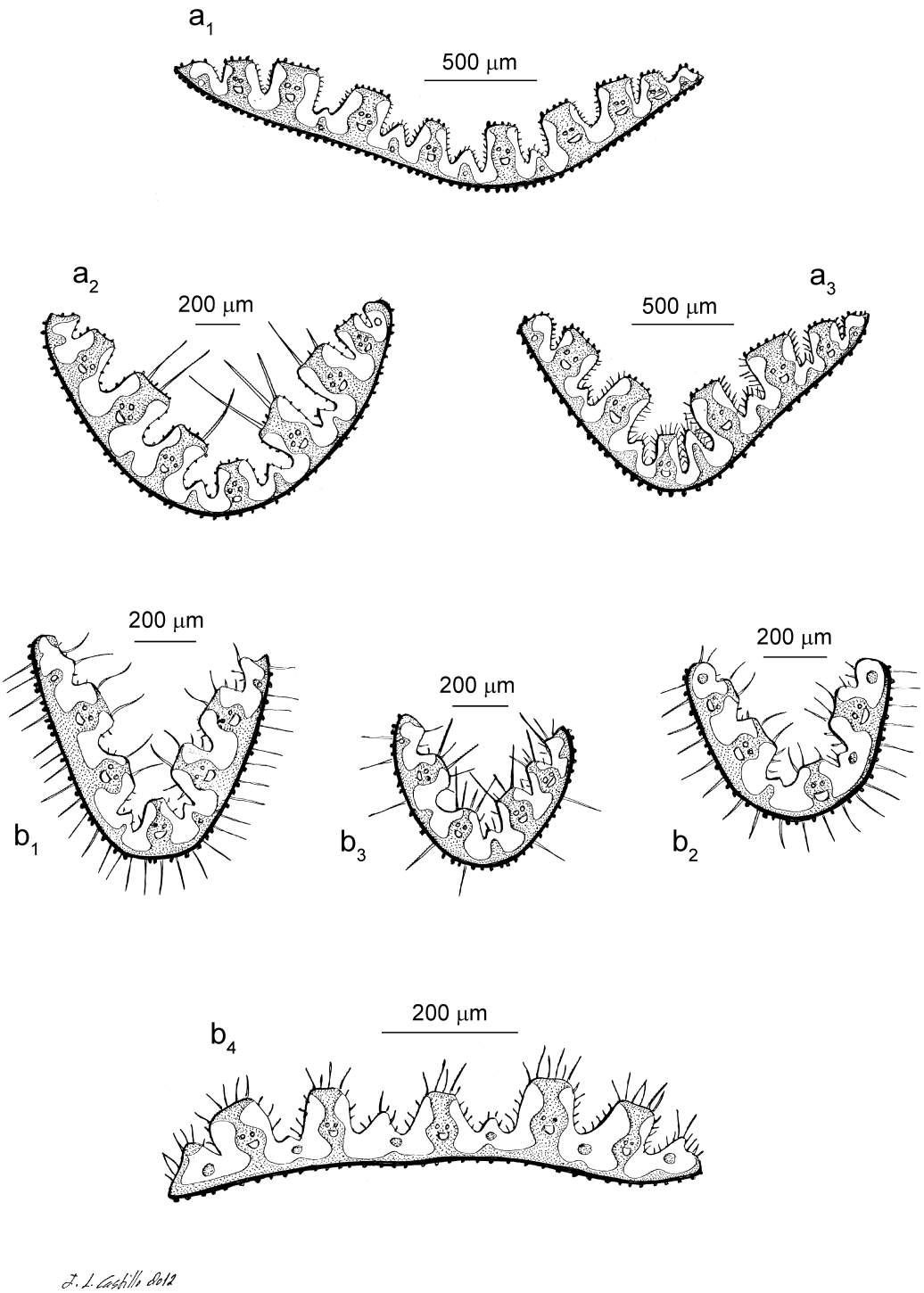

Figure 2. Transverse section of leaf–blades: a_1, *S. pulcherrima* subsp. *crassiculmis*; a_2, *S. pulcherrima* subsp. *crassiculmis* (sub. *S. crassiculmis* subsp. *heterotricha*); a_3, *Stipa pulcherrima* subsp. *pulcherrima*; b_1, *S. zalesskii* subsp. *zalesskii* (sub. *S. turcomanica*); b_2, *S. zalesskii* subsp. *ucrainica*; b_3, *S. zalesskii* subsp. *zalesskii* (sub. *S. zalesskii* var. *glabrata*); b_4, *S. zalesskii* subsp. *zalesskii* (sub. *S. cretacea*) [Based on: a_1, *Dvořák s.n.* (H); a_2, *Vašak s.n.*, 15 Jul 1975 (MA); a_3, *Greuter 16318* (MA); b_1, *Nikitin s.n.*, 23 May 1975 (MA); b_2, *Skvortsov s.n.*, 14 May 1970 (M); b_3, *Michelson 1471* (G); b_4, *Smirnow 47* (H)].

river Baisary–bikem–bai, 48° 14´ N 57° 1´ E, 7 Jun 1926, *Roshevitz, Il'In, and Avramchik 234* (NY). Kostany: Adaevskiy uezd. Between rivers Emba and Ust'–Urt. Slope of the mountain An–tau, 51° 48´ N 62° 2´ E, 9 Jun 1926, *Rozhevitz et al. 307* (LE). RUSSIA. Kalmkiya: Tselinniy Region, 16 km of Elista, 47° 46´ N 44° 27´ E, 2 Jun 1971, *Ikonnikov et al. 5493* (LE). Rostov: Novotscherkassk in declivio, 47° 25´ N 40° 5´ E, 26 May 1910, *Jakouschev s.n.* (WU); Ad Tanain inferiorem steppum stipaceum prope pag. Persianovka, non procul ab urbe Novotscherkassk, 47° 31´ N 39° 25´ E, 11 Jun 1928, *Smirnow 42* (B, H, JE, S, W). Volgogradskaya Oblast': 30–40 km S von Volgograd, unweit Dubovyi Ovray Am Rande, 48° 20´ N 44° 37´ E, 14 May 1970, *Skvortsov s.n.* (M). UKRAINE. Donetsk: Distr. Stalino. Inter pag. Stila et Karakuba. In schistosis ad fl. Volnovacha, 47° 40´ N 38° 4´ E, 21 May 1927, *Kleopov s.n.* (S); Melekino, 46° 57´ N 37° 24´ E, 20 May 1943, *Rauh s.n.* (JE); Stalin Region, Budennovsk District, village Khomutovo, reserve "Khomutovskaya steppe", 47° 15´ N 38° 8´ E, 15 Jun 1926, *Kleopov s.n.* (LE). Kherson: Chongar peninsula, Island Kunk–Tyun,, 46° 1´ N 34° 29´ E, 22 May 1969, *Kotov, M. s.n.* (H); Skadovsk–Khorly, on the northern coast of the Black Sea,, 46° 7´ N 32° 55´ E, 14 May 1948, *Pobedimova 103* (LE); Chongar peninsula, Island Kuyuk–Tyub in Sivash, 46° 15´ N 34° 25´ E, 23 May 1969, *Kotov, A. s.n.* (H). Krym: Tarkhankut. Collective farm Bol'shevik, 13th km of the highway Chernomorsk–Evpatoria, 45° 22´ N 34° 32´ E, 31 May 1956, *Novoseltseva and Krylov s.n.* (LE); Vicinity of Bakhchisaray, near Chufut–kale, 44° 44´ N 33° 58´ E, 20 May 1984, *Tzvelev et al. 768* (LE); Karadag, the frontal ridge, 44° 56´ N 35° 13´ E, 5 Jun 1962, *Kurchenko s.n.* (B). Luhansk: Voroshilovgrad Region, Perevalskiy District, the vicinity of the village Isakovo, 48° 28´ N 38° 54´ E, 30 May 1980, *Deripova s.n.* (LE)

Notes: *Stipa zalesskii* is extremely variable in ornamentation and in leaf morphology, which have lead to the description of many taxa at infraspecific or specific rank (Smirnow 1925, 1928, 1929; Tzvelev 1976, 1986). The original material and most of *S. zalesskii* specimens have leaves with abundant stiff hairs at the abaxial surface of the basal leaf–blade, which allows its identification even in vegetative stage. With such characters, *S. zalesskii* approaches the most eastern taxa, *S. dasyphylla* (Freitag, 1985), overlapping their distribution area in Ukraine, the European part of Russia and western Siberia. However, *S. dasyphylla* exhibits soft long hairs making it soft to the touch, instead of stiff hairs and prinkles that makes *S. zalesskii* rough to the touch. As well, some specimens of *S. atlantica* exhibit the abaxial surface of the basal leaf–blade pubescent, but only *S. zalesskii* and *S. dasyphylla* have hairs all along the leaf–blades length.

Smirnow (1928) described *S. rubens* prole *glabrata*, characterized by having the leaf–blades covered only by pointed prickles on the abaxial surface, sometimes mixed with scattered hard stiff hairs (Fig. 2 $b_{3)}$. Tzvelev (1964, 1986) changed the rank of the taxa several times from species to a variety of *S. zalesskii*. However, we have found a continuous variation of the basal–leaf ornamentation, from densely covered with stiff hairs to scabrous only by prickles. This variation is found in all the distribution areas of the species, being no basis for recognizing S. *zalesskii* var. *glabrata*, which is subsumed under *S. zalesskii*. Likewise, the leaf diameter varies extensively. Most of the populations have narrow leaves (0.3–0.6 mm in diameter), which superficially resembles specimens of *S. tirsa* (subsect. *Tirsae*). Even though, sporadically throughout the distribution area of the taxon, specimens with broader leaves (0.5–1 mm in diameter) are encountered. Equally, the basal leaf–sheath is extremely variable and commonly used at specific or subspecific differentiation (Tzvelev 1976; Martinovský 1982). In the identification key of Tzvelev (1976) one step is only based on the leaf–sheath features, being gathered taxa with short hairs and pinkish tinge (subsp. *pontica* and subsp.

turcomanica), and on the other hand taxa with glabrous or very short pilose leaf–sheaths (subsp. *zalesskii* and subsp. *cansecens*). However, these characters are not consistent enough to separate subspecies as many individuals show intermediate features.

Stipa zalesskii also includes individuals that differ in ornamentation and size of the spikelets. Specimens with long glumes (7.5–9.5 cm), lemma (19–23 mm) and awns (39–46 cm) were described as *S. turcomanica* by Smirnow (1925) and considered endemic from the Kopetdag Mountains. Nevertheless, this character is widely variable throughout the geographic range and therefore of scarce value for taxa delimitation (Freitag 1985). More sporadically, some specimens show hairy columns, and have been recognized as *S. iljinii* (Roshev 1932), but this character has been considered as spontaneous mutations (Tzvelev 1976; Scholz 1985). Special attention requires *S. ucrainica* (Smirnow 1929), which exhibits the typical ornamentation of *S. zalesskii*, but the lemma ventral rows end at least 2 mm below the lemma apex, instead of reaching the top as in *S. zalesskii*. *Stipa ucrainica* has been recognized as an easily identifiable species and general accepted on species level in recent floras and papers (Morariu 1972; Martinovský 1982; Apostolova et al. 2008). Nevertheless, the difference between both taxa becomes blurred in their contact areas in Ukraine (Krym) and East Europe (Fig. 2), where both forms can be found in the same specimens. Therefore, despite this unusual lemma feature (a disctinctive character of subsection *Stipa* and *Tirsae*), the affinity of this species clearly fulfills within *S. zalesskii* and according to Tzvelev (1976), it is considered with doubt as a subspecies of *S. zalesskii*.

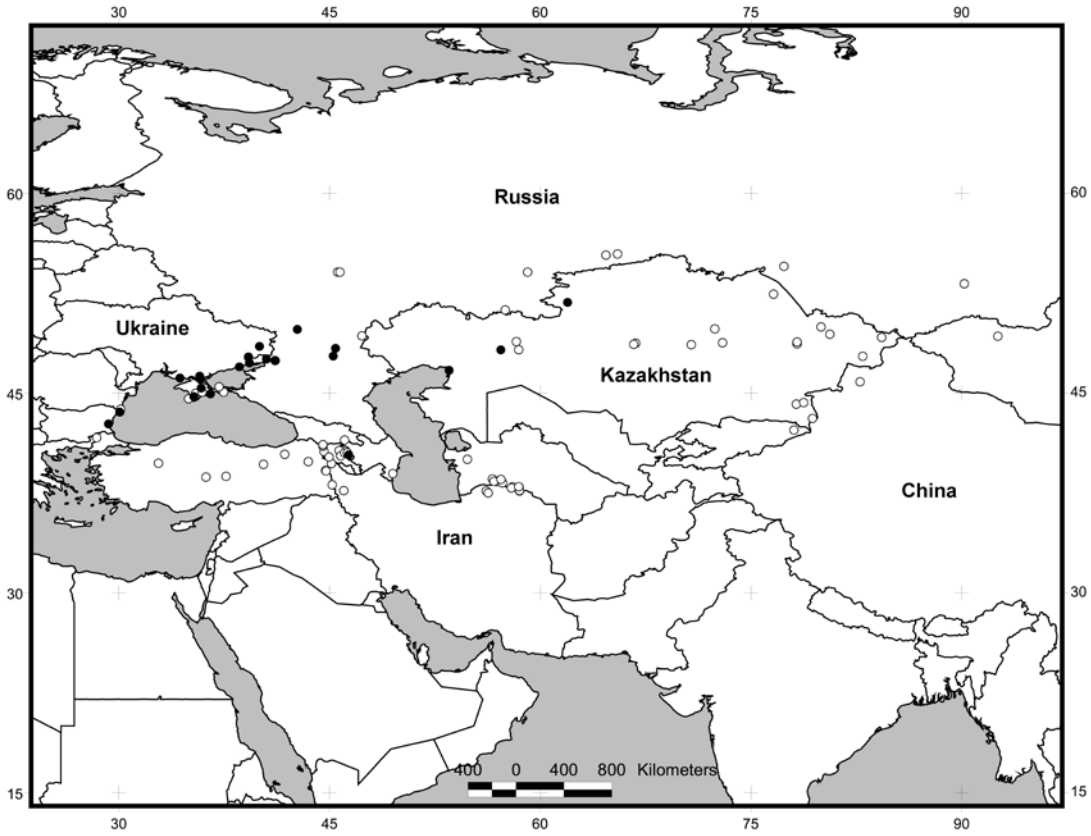

Figure 3. Distribution map: *Stipa zalesskii* subsp. *ucrainica* (●); *.S zalesskii* subsp. *zalesskii* (○).

2. *Stipa dasyphylla (Czern. ex Lindem.) Trautv*

Stipa dasyphylla (Czern. ex Lindem.) Trautv, Acta Horti Petrop. 9: 350. 1884; *Stipa dasyphylla* Czern., Konsp. Rast. Harkova: 75. 1859, nom. nud.; *Stipa pennata* [gamma] *dasyphylla* Czern. ex Lindem., Fl. Cherson. 2: 283. 1882; *Stipa pulcherrima* var. *dasyphylla* (Czern. ex Lindem.) Podp., Doplñky ku kvflené moravské: 19. 1914; *Stipa pulcherrima* var. *dasyphylla* (Czern. ex Trautv) Fed., Izv. Imp. Bot. Sada Petra Velikago. 14 (Suppl.): 48. 1915. *Type*: UKRAINE. Kharkov, on Knolls and hills of Rogan, 13 Jun 1853, *Chernyaev s.n.* (lectotype, LE! designated by Tzvelev, 1976; isolectotype LE!).
Stipa villifolia Simonkai, Természettud. Közl. 32: 44. 1895; *Stipa joannis* [unranked] *villifolia* (Somonkai) Jáv., Magyar Fl. 1: 69. 1924; *Stipa dasyphylla* var. *villifolia* (Somonkai) Borza, Consp. Fl. Roman.: 29. 1947. *Type*: HUNGARY. In Hungaria centralis. In aprtis graminosis montis Háromhatár supra Buda´–Uljak, Simonkai 3988 (lectotype, W 1913 13932!, designated here; isolectotypes GH!, H!, JE!, M!, NY!, PR!, W!, WU!)
Stipa joannis var. *eriosoma* Borbás in Dörfl., Jahres–Katal: 127. 1900, nom. nud; *Stipa joannis* var. *eriosoma* Borbás ex Borbás., Balat. Fl.: 316. 1900; *Stipa joannis* [unranked] *eriosoma* (Borbás ex Borbás) Jáv, Magyar Fl. 1: 69. 1924; *Stipa dasyphylla* var. *eriosoma* Borbás ex Soó, Acta Bot. Acad. Sci. Hung. 17: 123. 1971. *Type*: HUNGARY. Budae–Pestinae in montibus Aquinci, 5 Jun 1890, *Borbás s.n.* (lectotype, G 00080549!, designated here; isolectotypes, G!, JE!, WU!).

Herbs 32–70 cm high, perennial, caespitose; branching intravaginal. Culms 2–4 noded, nodes glabrous, violet; culm internodes usually pubescent, the remainder pubescent (rarely scabrous). Basal leaves 25–68 cm long, green; leaf–sheath minutely pubescent, glabrous or ciliate, cilia (0.15)0.25–0.52(0.55) mm long; leaf–blades 15–50(64) cm long, (0.4)0.5–0.7(0.8) mm in diameter, convolute, abaxial surface pubescent, hairs (0.6)0.7–1.3 mm long, adaxial surface pubescent or sparsely pilose, hairs (0.44)0.5–1.2 mm long; ligules (0.7)1.1–3.6(4.3) cm long, obtuse, rounded or lacerate, minutely pubescent or scabrous (rarely glabrous), ciliate or ciliolate (rarely glabrous), cilia (0.01)0.02–0.4 mm long. Floriferous culm leaves 26–52 cm long; leaf–sheath 21–39 cm long, scabrous with scattered hairs near the leaf–blade and margins, completely scabrous or papillae, margins glabrous; leaf–blade 5–17 cm long, (0.34).0.4–0.8 mm in diameter, abaxial surface scabrous or with sparsely stiff hairs, adaxial face pubescent (minutely pubescent with scattered hairs), hairs (0.23)0.4–0.7(0.8) mm long; ligules (2.7)3–6.4(7.3) mm long, acute, obtuse or bifid, scabrous or pilose, margins usually glabrous tip glabrous or ciliate, cilia (0.13)0.14–0.43(0.48) mm long. Panicle 21–52 cm long, contracted, exserted or partially enclosed by the upper leaf–sheath, 3–5(6) noded; basal internode (13)17–32(37) cm long, somewhat scabrous, pubescent (rarely glabrous); branches (1.8)1.9–3.7(4.5) cm long, patent or ascending, setaceous, setae (0.17)0.2–1.2(1.5) mm long; basal nodes with (1)2 branches with 1(2) spikelets each. Glumes subequal, lanceolate, long acuminate, glabrous and ciliate on the

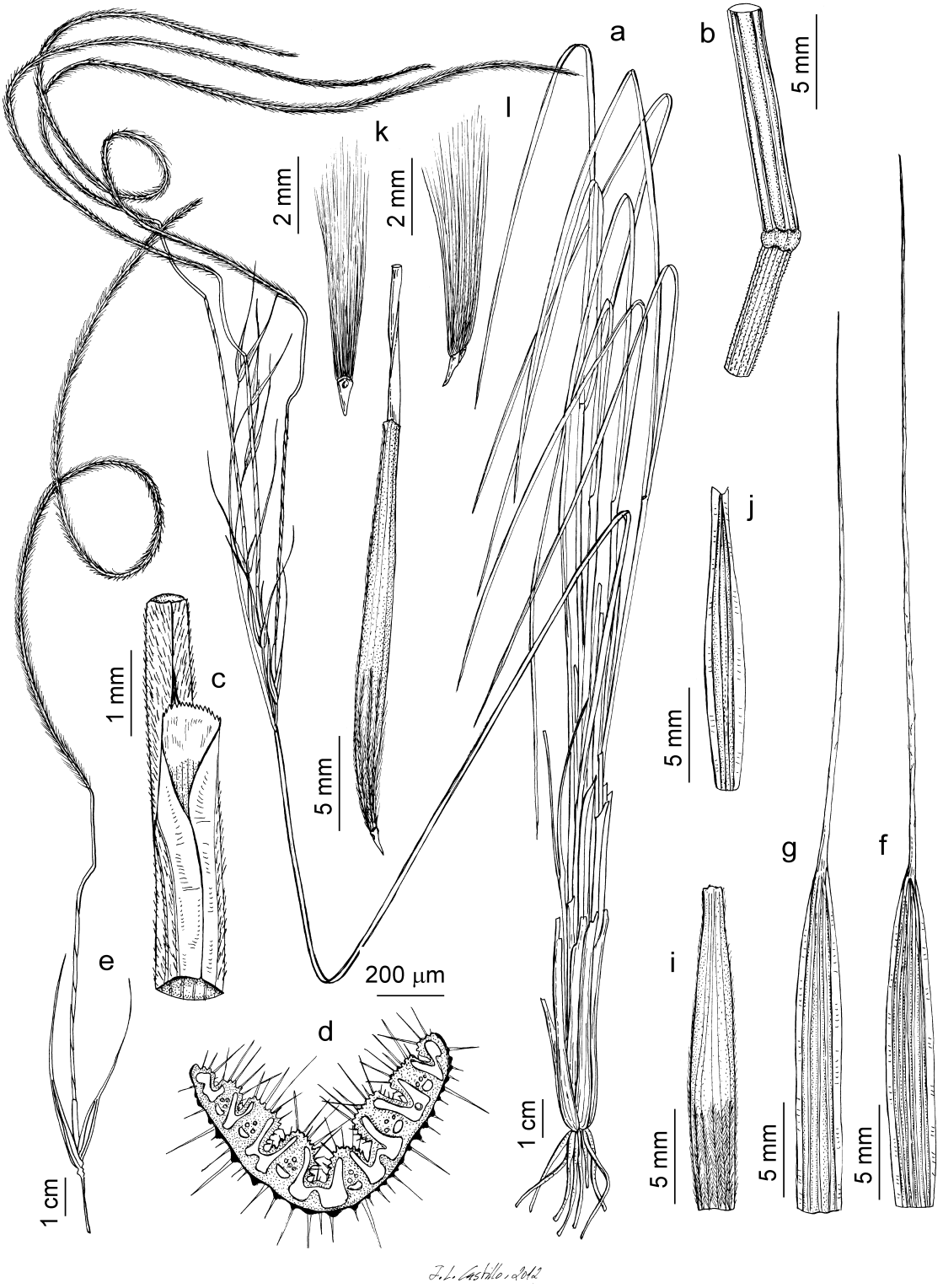

Figure 4. *Stipa dasyphylla.* A, habit; B, floriferous culm node; C, ligule, frontal view; D, transverse section of leaf–blade; E, spikelet; F, upper glume; G, lower glume; H, anthecium and column; I, lemma; J, palea; K, callus, ventral view; L, callus, lateral view. [Based on: *Suza 5565* (MA)].

central nerve, cilia (0.17)0.23–1.3(1.7) mm long, green with purple stains, margins and tip hyaline, the lower 5.6–8.5(9.7) cm long and 3–5 nerved, the upper 5–8.5(9.3) cm long and 5–8 nerved. Anthecium (16)18.7–22.2(22.7) mm long, 0.9–1.3(1.4) mm wide, fusiform, coriaceous, green, pale or brown; lemma (12.2)14.4–17.4(17.6) mm long, near the apex glabrous, with 7 rows of hairs, the dorsal and subdorsal ones fused and the remainder rows free, the ventral row reaching the top (rarely ending up to 0.5 mm below the top), the dorsal row measuring 1/3–1/4 the length of the lemma, the subdorsal rows ± equalling the dorsal rows and the lateral rows slightly longer, lemma with patent hairs 0.6–0.8(0.9) mm long; lemma apex glabrous; callus (3.8)4–5.2 mm long, acute, curved, villous, hairs (1.8)1.9–2.7(2.8) mm long on the ventral face and (1)1.1–1.6(1.7) mm long on the dorsal face, scar elliptic, peripheral ring 0.8–1(1.1) mm long, (0.25)0.27–0.37(0.38) mm wide (ratio wide/length= (0.27)0.3–0.41(0.42)); palea (12.2)12.8–15.9(16.9) mm long, lanceolate, margins and tip hyaline, dorsally 2–nerved, between the two nerves papillae or glabrous, margins glabrous and tip glabrous or ciliate, brown pale or green; lodicules 3, equal or subequal, with the dorsal ones slightly longer or shorter than the ventral one, acute, lanceolate or linear lanceolate, membranous, glabrous, dorsal lodicules 1.9–2.8(2.9) mm long, ventral lodicule (1.9)2.1–3.1(3.2) mm long. Awn (27)29–42(43) cm long, bigeniculate; column (5.1)6.3–9.2(9.3) cm long, base (0.53)0.54–0.7(0.8) mm in diameter, twisted, brown, brown and green and frequently with purple stains, glabrous; geniculation (1.6)1.7–2.5 cm long, glabrous, scabrous (rarely with scattered hairs), seta (19)21.8–33(34) cm long, (ratio column length/seta length= (0.21)0.23–0.38(0.41)), flexuous, plumose, hairs in lower part 3.8–5.7(5.8) mm long. Anthers 6.1–9(10.2) mm long, glabrous (rarely with scattered hairs), yellow. Ovary glabrous, styles two. Caryopsis 9.75–13.3 mm long, fusiform; embryo1.7–2.3 mm long. (Fig. 4)

Chromosome Number: Unknown.

Habitat and Distribution: Inhabits steppes, slopes of serpentine, limestone or calcareous soils from lowlands up to middle mountain belt, 250–2000 m. Especially common in Central Europe and the European part of Russia. Also present in Ukraine, North Caucasia and western Siberia. In this work has been recorded for the first time in Greece and Moldavia. *Stipa dasyphylla* was also reported from Romania (Martinovský 1982; Morariu 1972). Unfortunately it was not possible to examine the specimens supporting this record. (Fig. 5)

Phenology: Flowering and fruiting from May to August.

Representative Specimen Examined: AUSTRIA. Niederosterreich: Weinviertel Pulkautal: "Altenberg" 1.35 km NW Zellerndorf, 48° 41´ N 15° 57´ E, 18 May 1986, *Prockorny and Strudl, M. s.n.* (W). CZECH REPUBLIC. Jihomoravský Kraj. Moravia centralis Třebič, prope opp. Mohelno, 49° 6´ N 16° 11´ E, 7 Jun 1925, *Dvořak and Suza 163* (BR, G, GH, H, W, WU); In saxonis despentinis prope Mohelno Moravia, 49° 7´ N 16° 11´ E, May 34, *Dvorak s.n.* (M, MA); 40 km SW von Brno, 49° 23´ N 16° 28´ E, 22 May 1959, *Smiedt 366* (U). Vysočina: Ad rupes serpentinas callidissimas supra fluvium "Iglava" ad "Mohelno" prope "Trebitsch", 49° 12´ N 15° 52´ E, Jun 1911, *Suza 5565* (C, BR, G, JE, M, MA, PR, S, W, WU). GERMANY. Sachsen–Anhalt: Steinklobe bei Nebra, 51° 17´ N 11° 34´ E, 28 Jun 60, *Bisse s.n.* (JE); Nebra Steinklöbe, 51° 17´ N 11° 34´ E, 1963, *Henisil s.n.* (JE). GREECE. Anatolikí Makedonía kai Thráki: Thrakien: ca. 1–2 km S von MeriÇ. Nehri, 41° 39´ N 26° 27´ E, 23 May 1979, *Krendl s.n.* (W). HUNGARY. Budapest: Budae–Pestini, in montibus Aquinci, 47° 34´ N 19° 4´ E, 5 Jun 1890, *Borbás s.n.* (G, JE, WU); In herbidis siccis montis Tábor–hegy, 47° 23´ N 16° 29´ E, 2 Jun 1944,

Boros s.n. (S); Budae–Pestini in montibus Aquinci, 47° 34´ N 19° 4´ E, 5 Jun 1899, *Dörfler s.n.* (W); In herbidis siccis montis Tábor–hegy, 47° 23´ N 16° 29´ E, 2 Jun 1944, *Boros s.n.* (W). Fejér: Montes Vaskapu–Hegi prope Lovasberény, 47° 18´ N 18° 33´ E, 6 Jun 1937, *Boros s.n.* (W). Nógrád: Háromhatárhegy ad Budapestinum, 48° 5´ N 19° 54´ E, 2 Jun 1902, *Degen and Flatt 11* (JE, W, WU); In pratis graminosis montis Háromhatár supra Buda´–Uljak, 48° 6´ N 19° 55´ E, *Simonkai 3988* (GH, H, JE, PR, M, NY, W, WU). KAZAKHSTAN. East Kazakhstan: Kalbinskiy Range, mountain Kok–tau, near Sebinskie lakes, 49° 33´ N 82° 38´ E, 5 Jul 1965, *Junatov 6* (LE). MOLDAVIA. Cimislia: To the east of village Batyr, Chimshiliyskiy District, on the glade, 46° 34´ N 29° 0´ E, 28 May 1958, *Shabanova s.n.* (LE). RUSSIA. Bashkortostan: Zilair District. 3 km to SE from village Mrakova, 53° 47´ N 56° 11´ E, 3 Jul 1928, *Knorring 177* (LE). Chelyabinskaya: The Southern Ural, the vicinity of Miass plant, (Ilmen Range), 55° 15´ N 60° 12´ E, 7 Jul 1926, *Tyulina s.n*. (LE); Argayash District, at 6.5 km to the east–south–east of village Zyryankul', 55° 59´ N 61° 20´ E, 10 Jul 1930, *Lind 478* (K, L, LD); Mesyagutovskiy

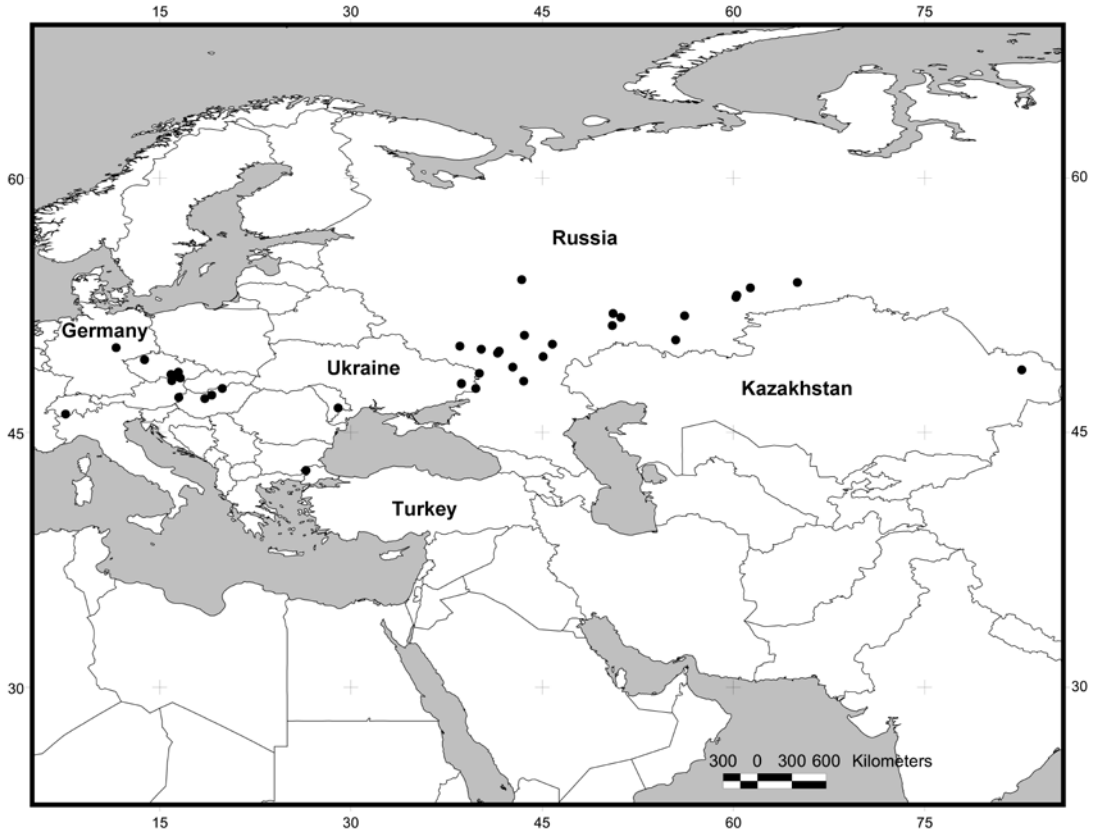

Figure 5. Distribution map: *Stipa dasyphylla* (●).

District. Meadow steppe between villages Mukhametovo and Ibraevo, 55° 24´ N 60° 15´ E, 1928, *Mikhailov 423/2* (LE). Kurganskaya: Between village Mostovskoye and village Belaya, 56° 25´ N 65° 1´ E, 25 Aug 1928, *Ivanova and Shihova 2280* (LE). Nizni Novogrod: Zavolzhie, opposite the village Barataevskye mari, 56° 38´ N 43° 23´ E, 9 Aug 1932, *Rodin and Lebedev 556* (LE). Oremburg: Eastern Slope of Obschiy Syrt. Kashirinskiy District. The northern slope to the spur of the dry gully Myasnikovskiy, 51° 53´ N 55° 28´ E, 8 Jun 1924, *Smirnova 715* (LE). Samarskaya: Sergiev District, the vicinity of Sernovodsk, to the north of Sernovodsk, 53° 41´ N 51° 10´ E, 23 Jun 1931, *Gorodkova 589* (LE); Donskaya Region, Sal'skiy District, the area of Western Horse Farms, 53° 59´ N 50° 34´ E, 23 Apr 1926, *Bondareva s.n.* (LE); Samaro–Mar'evskiy sovkhoz (state farm), 2 km to the south–west of Central part of Sovkhoz, 53° 1´ N 50° 29´ E, 30 May 1930, *Bazhanov 40* (LE). Saratovskaya: In viciniia urb. Saratov prope pag. Razboisczina, 51° 34´ N 45° 49´ E, 4–5 Jun 1917, *Janischevkij 4903* (C, G, H, JE, W); Near village Polivanovka, 52° 16´ N 43° 36´ E, 1 Jun 1927, *Fedtchenko and Bobrov 9* (LE). Volgograd: Vicinia vici Perestchepnoie, distr. Kamyschin, 50° 35´ N 45° 5´ E, 6 Jun 1999, *Weber s.n.* (BR); Don supra Kalatsch prope Trëkhostrovskayaa, 48° 40´ N 43° 32´ E, 22 May 1972, *Skvortsov s.n.* (GH, NY);

Uriupinsk prope Bespalovskii, 50° 52´ N 41° 31´ E, 1 Jun 1985, *Skvortsov s.n.* (M); Vicinia vici Perestchepnoie distr. Kamyschin, 50° 35´ N 45° 5´ E, 6 Jun 1999, *Skvortsov and Schanzer 19934* (G, H, MA); Village Zloty, 51° 25´ N 38° 33´ E, 16 Jun 1958, *Tsygikolo s.n.* (LE); Kumylzhenskiy District, near the fomer village Chiganaki, 49° 45´ N 42° 42´ E, 19 Jul 2001, *Firsov 5905* (LE). Vorozhneskaya: Bobrovskiy District, reserve "Kamennaya steppe", 51° 1´ N 41° 38´ E, 17 Jun 1923, *Ditmer s.n.* (LE); Bobrovskiy District, Khrenov'e, Kazennaya steppe: Shestikurganniy cordon, 51° 10´ N 40° 13´ E, 25 Jul 1913, *Orlov s.n.* (LE). SWITZERLAND. Valais Branson: (Kanton Wallis) bei Les Follatères, 46° 4´ N 7° 36´ E, 18 May 1990, *Derunova s.n.* (W). UKRAINE. Donetsk: Elevatio Donetz. Steppum stipaceum <<Provalje>> prope st. viae ferreae <<Krasnaja mogila>>, 48° 5´ N 39° 47´ E, 20 Jun 1928, *Smirnow 26* (FI, G, H, L, S, W). Luhans´ka: Voroshilovgrad Region, town Bryanka, the vicinity of the village Zamkovka, 48° 30´ N 38° 39´ E, 18 May 1990, *Deripova s.n.* (W); Melovskoy District, the western boundary of the reserve "Streletskaya step", 49° 17´ N 40° 4´ E, 11 Jun 1958, *Dubovik s.n.* (LE). Oknennaya: Voroshilovgrad Region, town Bryanka, the vicinity of the village Zamkovka, 48° 28´ N 38° 41´ E, 1 Jun 1980, *Deripova s.n.* (LE).

Notes: Stipa dasyphylla is one of the easiest species in the subsection to be recognized. Beside the similarity of the spikelets with the other species of the subsection, it has the basal leaves covered by abundant soft hairs (0.6)0.7–1.3 mm long. The most similar species and from which can be confused is *S. zalesskii*, which has the basal leaves covered by prickles and abundant rigid hairs (0.1)0.3–0.6(0.9) mm long. Both species can become blurred especially in their contact areas in Ukraine and Russia. However *S. dasyphylla* is more abundant in Central Europe and East Europe, while *S. zalesskii* is more abundant in the Caucasus, Asia and Siberia. As well, the different type of hairs, soft to the touch in *S. dasyphylla* and rough in *S. zalesskii*, made us consider both taxa different species.

More recently, Martinovský and Scholz (1968) described *S. bavarica* Martinovský from Germany, characterized by having the abaxial surface of the basal leaves covered by short soft hairs. However, this specimens looks like a small aberration forms found among populations of *S. pulcherrima*. These plants show several basal leaves completely scabrous and without hairs, and the hairy leaves have hairs only on half of its length. However, the adaxial surface is identical to *S. pulcherrima*, with short hairs in the furrows and scabrous at the apex of the rib, whereas *S. dasyphylla* has the basal leaves hairy and throughout its length and with the adaxial surface with sparse or abundant long hairs.

3. Stipa atlantica P.A. Smirn.

Stipa atlantica P.A. Smirn., Repert. Spec. Nov. Regni Veg. 26: 270. 1929. *Type*: ALGERIA. Dhalga, June 1853, Munby fr. Mat. s.n. (holotype, LE!).
Stipa iberica Martinovský, Feddes Repert. 73: 150. 1966; *Stipa pennata* subvar. *iberica* (Martinovský) O. Bolòs and Vigo, Fl. Països Catalans 4: 546. 2001; *Stipa pennata* var. *iberica* (Martinovský) O. Bolòs and Vigo, Fl. Països Catalans 4: 546. 2001; *Stipa pennata* subsp. *iberica* (Martinovský) O. Bolòs, Masalles and Vigo, Collect. Bot. (Barcelona) 17(1): 96. 1987. *Type*: SPAIN. Herdam, May 1875, *Agelet s.n.* (holotype, FI, digital image!).
Stipa apertifolia Martinovský, Preslia 39: 274. 1967. *Type*: SPAIN. Cuenca Jun 1898, *Gondoger s.n.* (holotype, PR digital image!)

Stipa iberica f. *levis* Martinovský, Anales Inst. Bot. Cavanilles 27: 74. 1970; *Stipa pennata* subvar. *levis* (Martinovský) O. Bolòs and Vigo, Fl. Països Catalans 4: 546. 2001. *Type*: SPAIN. Val de Llo, *Sennen s.n.* (holotype, LD).
Stipa iberica var. *pygmaea* Martinovský, Anales Inst. Bot. Cavanilles 27: 74. 1970; *Stipa pennata* subvar. *pygmaea* (Martinovský) O. Bolòs and Vigo, Fl. Països Catalans 4: 546. 2001. *Type*: SPAIN. In Monserrat, Jun 1896, *Vayreda s.n.* (holotype, MA!).
Stipa iberica subsp. *pauneroana* Martinovský, Anales Inst. Bot. Cavanilles 27: 74. 1970; *Stipa pauneroana* (Martinovský) F.M. Vázquez and Devesa, Acta Bot. Malacitana 21: 143. 1996; *Stipa pennata* var. *pauneroana* (Martinovský) O. Bolòs and Vigo, Anales Inst. Bot. Cavanilles 4: 547. 2001. *Type*: SPAIN. Aranzueque (La Alcarria), 28 May 1965, *Buendía s.n.* (holotype, MA!).
Stipa iberica f. *pseudodasyphylla* Martinovský, Anales Inst. Bot. Cavanilles 27: 75. 1970; *Stipa iberica* var. *pseudodasyphylla* (Martinovský) F.M. Vázquez and Devesa, Acta Bot. Malacitana 21: 141. 1996; *Stipa iberica* subsp. *pseudodasyphylla* (Martinovský) Romo, Soc. Échange Pl. Vasc. Eur. Occid. Médit. 28: 123. 2000. *Type*: SPAIN. Renera (La Alcarria) J.R. del Castillo (holotype, MA!).
Stipa iberica subsp. *austro–iberica* H. Scholz, Willdenowia 19: 129. 1989; Stipa *iberica* var. *austro–iberica* (H. Scholz) F.M. Vázquez and Devesa, Acta Bot. Malacitana 21: 142. 1996. *Type*: SPAIN. Prov. Jaen, Sierra de Mágina bei Huelma 8 Jul1979, *Ern 3713* (holotype, B!)
Stipa apertifolia var. *nevadensis* F.M. Vázquez and Devesa, Acta Bot. Malacitana 39: 139. 1996. *Type*: SPAIN. Granada, Sierra de Baza, Torres J., Blanca G. and Morales C (holotype, GDAC!).
Stipa iberica subsp. *bolosii* Romo, Sierra, L. Torres and A.C. Cervi in Acta Bot. Barcinon. 45: 214. 1998; *Stipa iberica* var. *bolosii* FM. Vázquez and M. Gutierrez, Telopea 13: 163. 2011. *Type*: SPAIN. Pallars Sobirà, Esterri d´Àneu, voltants del poble, *Romo R 0001* (holotype, BC).
Stipa almeriensis F.M. Vázquez, Acta Bot. Malacitana 31: 78. 2006. *Type*: SPAIN. Almería: Minas de Almagrera, 19 Jun 1984, *Guirado* s.n. (holotype, ALME).
Stipa hispanica Martinovsky, in sched. nom .nud.

Herbs 29–63 cm high, perennial, small tufts; branching intravaginal. Culms 2–3 noded, nodes glabrous, violet or brown; culm internodes usually pubescent below the node, the remainder pubescent or scabrous. Basal leaves 14–74 cm long, green; leaf–sheath usually minutely pubescent, ciliate (rarely glabrous), cilia (0.14)0.21–0.61(0–72) mm long; leaf–blade 8–49 cm long, (0.34)0.41–0.66(0.73) mm in diameter, convolute, abaxial surface highly scabrous (rarely somewhat scabrous or glabrous), adaxial surface totally pubescent, scabrous, papillae or scabrous with scattered hairs or with long hairs (0.06)0.1–0.52(0.6) mm long near the margins, furrows scabrous or papillae; ligules (0.54)1.1–4.1(4.95) cm long, obtuse, rounded or acute, glabrous, scabrous or pubescent, ciliate or ciliolate, cilia 0.01–0.42(0.54) mm long. Floriferous culm leaves 23–50 cm

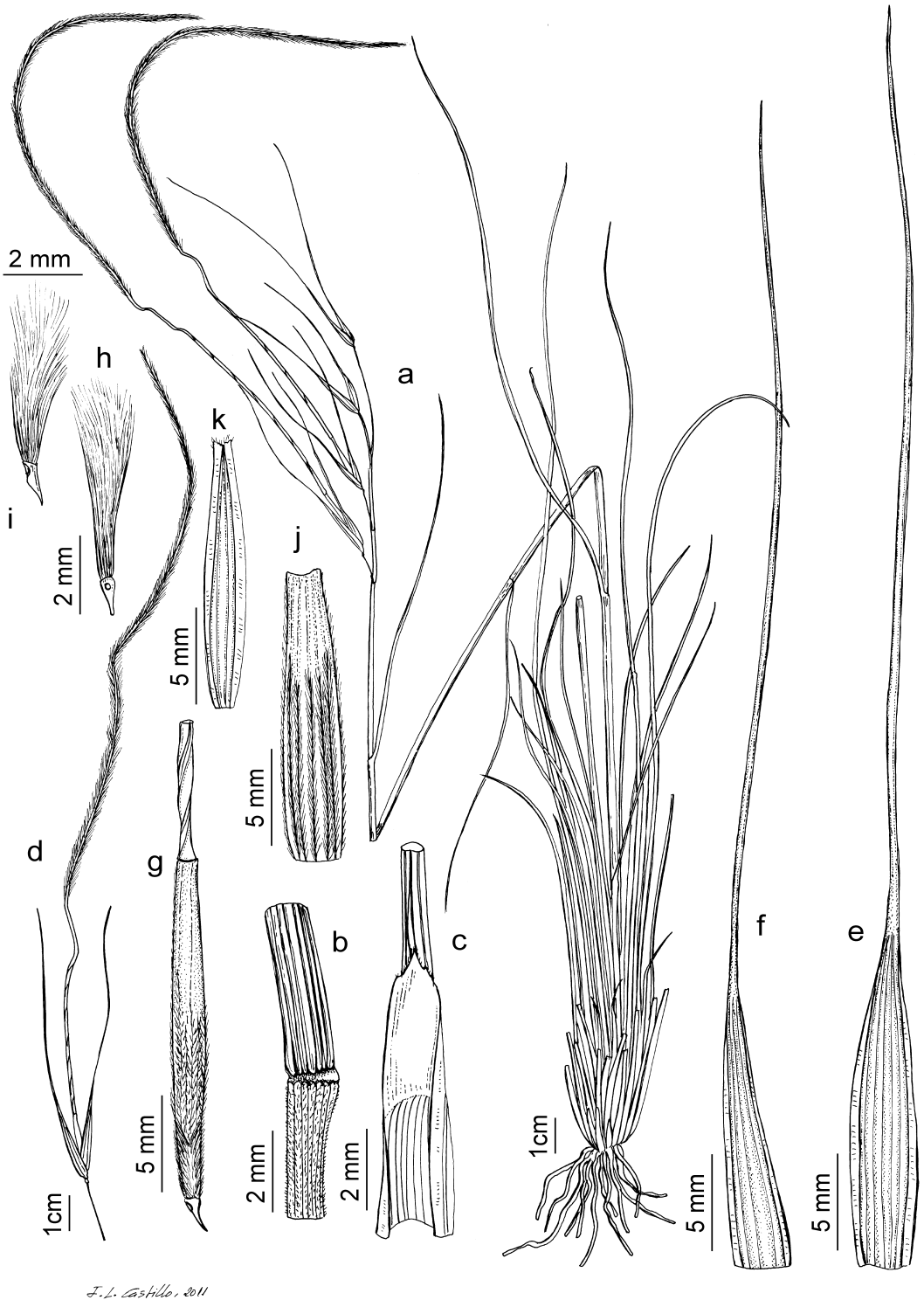

Figure 6. *Stipa atlantica*. A, habit; B, floriferous culm node; C, ligule, frontal view; D, spikelet; E, upper glume; F, lower glume; G, anthecium and column; H, lemma; I, palea; J, callus, ventral view; K, callus, lateral view. [Based on: *Gonzalo, R. 1023* (MA)].

long; leaf–sheath 20–36 cm long, scabrous with scattered hairs near the leaf–blade and margins, or completely scabrous or papillae, margins glabrous; leaf–blade 1.5–19 cm long, (0.15)0.25–0.62(0.72) mm in diameter, abaxial surface scabrous (rarely glabrous or with sparsely stiff hairs), adaxial face pubescent or scabrous, hairs (0.11)0.14–0.45(0.58) mm long; ligules (1.2)2.7–7.7(9.7) mm long, acute, lacerate, rounded (rarely obtuse), scabrous or pubescent, margins and tip glabrous, ciliate or ciliolate, cilia (0.01)0.04–0.75(1.1) mm long. Panicle 18–52 cm long, contracted, exserted or partially enclosed by the upper leaf–sheath, (2)3–4(5) noded; basal internode (8)13–33(43) cm long, scabrous, scattered pilose or pubescent; branches (1.1)2–5(6.9) cm long, patent or ascending, minutely setaceous or setaceous, setae (0.05)0.25–0.89(1.08) mm long; basal nodes with 1–2 branches with 1(2) spikelets each. Glumes subequal, lanceolate, long acuminate, glabrous, rarely ciliate on the central nerves, cilia 0.12–1.15 mm long, green with purple stains, margins and tip hyaline, the lower (4.4)6.5–9.1(11) cm long and 3–5(8) nerved, the upper (4.2)5.9–8.4 cm long and 5–7(9) nerved. Anthecium (16.11)18.1–22.8(25.1) mm long, (0.88)1.02–1.43(1.67) mm wide, fusiform, coriaceous, green, pale or brown; lemma (12.5)13.8–17.5(19.4) mm long, near the apex glabrous, with 7 rows of hairs, with the dorsal and subdorsal ones fused and the remainder rows free, or 6 rows of hairs with the dorsal row absent, the ventral row reaching the top, rarely ending below the top, the dorsal row measuring 1/2–3/4 the length of the lemma or absent, the subdorsal rows longer or slightly shorter than the dorsal row and the lateral rows always longer than the dorsal and subdorsal rows, patent hairs (0.46)0.52–0.78(0.92) mm long; apex glabrous; callus (3.6)4.2–5.6(6.1) mm long, acute, curved, villous, hairs (1.4)1.7–2.9(3.4) mm long on the ventral face and (0.86)1–1.7(1.8) mm long on the dorsal face, scar elliptic, peripheral ring (0.9)1–1.33(1.53) mm long, (0.3)0.32–0.41(0.45) mm wide (ratio wide/length= (0.24)0.27–0.34(0.39)); palea (12.2)12.7–17(18.8) mm long, lanceolate, margins and tip hyaline, dorsally 2–nerved, between the two nerves papillae or glabrous, margins glabrous and tip usually ciliate, rarely with a dorsal row of hairs up to 1/4–1/2 the length of the palea, green or brown pale; lodicules 3, equal or subequal, with the dorsal ones slightly longer or shorter than the ventral one, acute, lanceolate or linear lanceolate, membranous, glabrous or the dorsal ones ciliate at the apex, dorsal lodicules (2)2.3–3.7(4) mm long, ventral lodicule (1.8)2.1–3.3(3.7) mm long. Awn (20)25–36(42) cm long, bigeniculate; column (5.8)6.4–9.5(10) cm long, base (0.55)0.62–0,76(0.8) mm in diameter, twisted, brown, brown and green (rarely with purple stains), glabrous, tuberculate or scabrous; geniculation(1.4)1.6–2.5(2.8) cm long, tuberculate scabrous or with scattered hairs (rarely glabrous); seta (14.5)17.2–26.5(33) cm long, (ratio column length/seta length = (0.26)0.29–0.45(0.48)), flexuous, plumose, hairs in lower part (2.6)4.5–6.1(6.7) mm long. Anthers (6.9)7.5–11.4(13.3) mm long, usually glabrous, yellow or purple. Ovary glabrous, styles two. Caryopsis (9.1)9.9–12.8(14.1) mm long, fusiform; embryo (1.2)1.5–2.5(2.6) mm long. (Fig. 6; 7 a_1–a_5)

Chromosome Number: 2*n*= 44 Vazquez and Devesa, 1996

Habitat and Distribution: *Stipa atlantica* occurs in different habitats of calcareous and gypsum soils: pastures, borders of cultured fields, forest glades, sub steppes, rocky slopes and serial vegetation from lowlands to the summit of the

mountains, 100–2100 m. Endemic of South and central Spain, south France and the Atlas range of Morocco and Algeria. (Fig. 8)

Phenology: Flowering and fruiting from June to the beginning of August.

Represetative Specimens Examined: ALGERIA. Naâma: Aïn Safra: in pascuis montium ad Ras–Chergui, 32° 41´ N 0° 32´ W, 3 Jun 1899, *Chevallier 381* (BR, JE, K, MPU, UPS, W, WAG, WU). FRANCE. Languedoc–Roussilion: Montarnaud, 43° 39´ N 3° 41´ E, 20 May 1878, *no collector* (G); Herault: St. Martin de Londre, 43° 47´ N 3° 44´ E, 21 May 1999, *Lang s.n.* (M, W); In lapidosis montanis Dijon, 43° 57´ N 3° 11´ E, 1841, *Marth s.n.* (BR); Montpellier, 43° 37´ N 3° 49´ E, May 1893, *Geerinck–Coutrez 4307* (L); Valmarques Montpellier, 43° 36´ N 3° 53´ E, Jun 1855, *Planchon s.n.* (BR, L, UPS); Herault, Montornaud, 43° 37´ N 3° 47´ E, 18 May 1851, *Lange s.n.* (S). Midi–Pyrénées: Montpellier, Fontfroide, near du Lironde, 43° 7´ N 2° 53´ E, 10 May 1931, *Kümmel, K. 152* (WAG); Esterre, 42° 51´ N 0° 0´ E, 9 Jun 1936, *Bloembergen 1872* (L). Provence–Alpes–Côte d´Azur: Bouches–du Rhône, 43° 30´ N 5° 0´ E, 17 May 1912, *Delma 970* (BR); Km O van Cavallion, 43° 50´ N 5° 20´ E, 3 May 1952, *Reijnders s.n.* (BR); Limans, 43° 59´ N 5° 44´ E, 24 Jul 1982, *Geerinck–Coutrez 2874* (BR); 5 Km O van Cavallion, foot of Mountagne du Luberón, 43° 50´ N 5° 20´ E, 3 May 1952, *Reijnders 1069* (BR, WAG). Rhône–Alpes: Lyon a Sathonnay, 45° 49´ N 4° 52´ E, n.d., *Jordan s.n.* (G), Vagnas, 44° 21´ N 4° 23´ E, 2 Jun 1969, *Berghen s.n.* (BR). MOROCCO. Alhucemas, 35° 0´ N 4° 15´ E, Jul 1908, *Gandoger s.n.* (G). SPAIN. Álava: Barrundia, entre el caserío Urizxar y cerro Arbulo, 42° 55´ N 2° 30´ W, 12 Jun 1996, *P.M. and X Uribe–Echebarria 605* (GDA, MA); Gordoa, 42° 53´ N 2° 23´ W, 17 Jun 1984, *Uribe–Echebarria, P.M. 95* (M, MA, SEV, WU). Albacete: Alpera, sierra de Mugrón, 38° 57´ N 1° 13´ W, 27 May 1987, *Villanueva et al. 791* (MA). Almería: Sierra de Filabres, Calar Alto, 37° 13´ N 2° 32´ W, 12 Jun 2002, *Aedo et al. 7857* (MA); Sierra de Alfacar, La Alfaguara. Pico Calasbozo, 37° 42´ N 2° 14´ W, 25 Jul 1975, *Romero, A.T. and Morales, C. s.n.* (GDA). Burgos: Aranda de Duero, 41° 40´ N 3° 41´ W, Jun 1942, *Caballero López s.n.* (MA); Treviño: Albaina, 42° 43´ N 2° 45´ W, 25 Jun 1983, *Alejandre, J.A. 1815–83* (MA); Castro de Fuentidueña, 41° 25´ N 3° 51´ W, 10 Jun 1990, *Alejandre, J.A. 875–89* (MA); Rebolledo de la Torre: Albacastro, 42° 41´ N 4° 10´ W, 10 Jun 1990, *Betoño and Alejandre, J.A. 1204/90* (MA); Carazo, 41° 57´ N 3° 21´ E, 13 Jul 1989, *Zuñiga and Alejandre, J.A. 767–89* (MA); Medina de Pomar, Quincoces de Yuso, 42° 59´ N 3° 14´ W, 3 Jul 1991, *Alejandre 596/91* (MA). Cantabria: San Emiliano (Mts Cantabriques), 43° 15´ N 6° 49´ W, 8 Jul 1974, *Berghen s.n.* (BR). Ciudad Real: Torralba del Moral, 41° 8´ N 2° 30´ W, 3 Jun 1983, *Segura–Zubizarreta, A. 24647* (H, MA); Carretera CM 412, km 152 dirección a Villanueva de la Fuente, 38° 42´ N 2° 42´ W, 22 May 2007, *Gonzalo, R. and De la Estrella 706* (MA); Entre la Solana y la Alhambra, 38° 55´ N 3° 8´ W, 22 May 2007, *Gonzalo, R. and De la Estrella 701* (MA). Cuenca: Honrubia a Motilla de Palancar, 39° 35´ N 2° 12´ W, 6 Jun 1976, *Jiménez, J.A. and López, G. 1269 GF* (MA); Pico Mazmorra (Aliaguilla) XK40, 39° 44´ N 1° 19´ W, 20 Jun 1978, *Mateo s.n.* (MA); Hontecillas, 39° 42´ N 2° 11´ W, 25 May 2002, *Alarcón 110 (1)* (MA): El Negron, hacia Manzanaruela, 39° 55´ N 1° 18´ W, 21 Jun 1986, *Mateo and Figuerola s.n.* (MA); Beteta, 40° 34´ N 2° 3´ W, 13 Jul 1932, *Caballero, A. s.n.* (MA); Motilla del Palancar, 39° 31´ N 1° 53´ W, 24 May 2007, *Gonzalo, R. and De la Estrella 737* (MA). Granada: Santiago de la Espada a la Puebla de Don Fabrique, 38° 0´ N 2° 28´ W, 12 Jun 2008, *Gonzalo, R. and Jiménez, A. 1037* (MA); Collado de la Sagra, Carretera de la Puebla de Don Fabrique a Cabañas de la Sierra, 37° 53´ N 2° 31´ W, 12 Jun 2008, *Gonzalo, R. and Jiménez, A. 1051* (MA); Carretera de Escullar a Caniles, 37° 19´ N 2° 46´ W, 13 Jun 2008, *Gonzalo, R. and Jiménez, A. 1121* (MA); Dehesa de Alfacar, 37° 14´ N 3° 33´ W, n.d., *Tortosa s.n.* (GDA); Huescar. Sª Sagra. Proximo al Cortijo El Ferrario, 37° 48´ N 2° 32´ W, 11 Jul 1978, *Negrillo s.n.* (GDA); Padul, Sierra Nevada. Sierra del Manar. Cerro Domingo, 37° 1´ N 3° 37´ W, 26 Jun 1984, *Pérez Raya y Molero Mesa s.n.* (GDA); SW Alhama de Granada. An der Strabe (335/340) zw. Km 38 u. 39. 18–43, 37° 0´ N 3° 54´ W, 19 May 1997, *Lewejohann and Müller 97–458* (GOET); Jayena, 36° 56´ N 3° 49´ W, 8 Jun 1991, *García, S. and Vázquez, F.M. s.n.* (UNEX); Cúllar Baza, Rambla Pozo Iglesias, 37° 31´ N 2° 40´ W, 11 Jun 1995, *Bruno Navarro Reyes* (GDA). Guadalajara: Entre Terzaga y Chequilla km. 3, 40° 40´ N 1° 52´ W, 13 Jul 1965, *Paunero and Rivas s.n.* (MA); Entre Alcolea del Pinar y Aguilar de Anguita, 41° 2´ N 2° 26´ W, 9 Jul 1965, *Paunero s.n.* (MA); Alcolea del Pinar, 41° 2´ N 2° 28´ W, 16 Jun 1990, *García S. and Vázquez, F. M. s.n.* (PR); Checa, rio Cabrillas, carretera de Checa a Orea, km 3,5, 40° 34´ N 1° 44´ W, 21 Jun 1995, *Carrasco, M.A., Castilla, F., Martin Blanco, C. and Monasterio, E. 728FCL* (MA); La Alcarria,

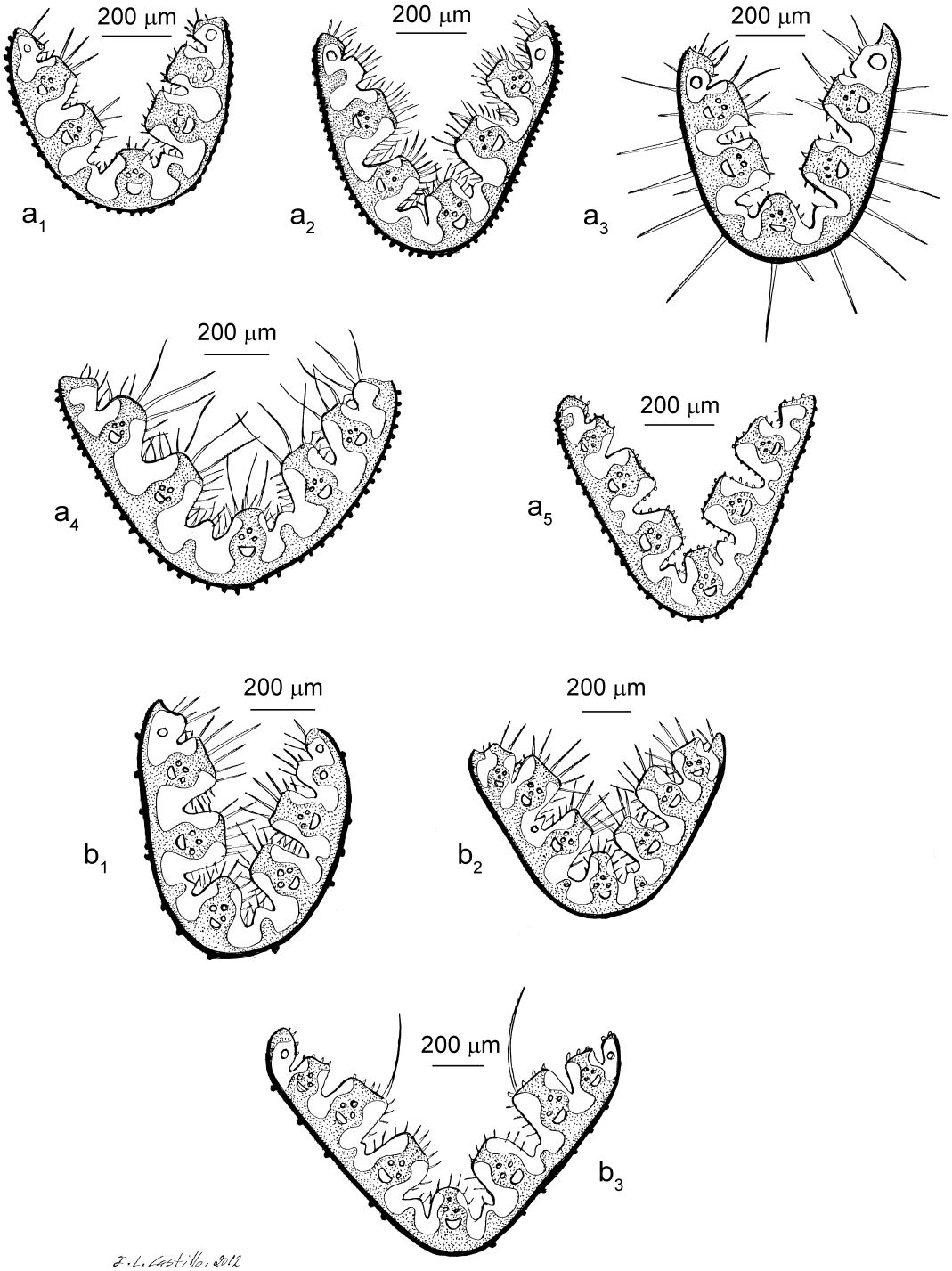

Figure 7. Transverse section of leaf–blades: a_1, *Stipa atlantica* (sub. *S. iberica* subsp. *pauneroana*); a_2, *S. atlantica* (sub. *S. iberica* subsp. *iberica*); a_3, *S. atlantica* (sub. *S. iberica* f. *pseudodasyphylla*); a_4, *S. atlantica*; a_5, *S. atlantica* (sub. *S. iberica* subsp. *austroiberica*); b_1, *S. austroitalica* subsp. *austroitalica*; b_2, *S. austroitalica* subsp. *sicula*; b_3, *S. austroitalica* subsp. *austroitalica* (sub. *S. oligotricha*). [Based on: a_1, *Gonzalo R and Jiménez A 1023* (MA); a_2, *Galán Cela and Martin 607* (MA); a_3, *Romo 13868* (MA); a_4, *Chevallier 381* (JE); a_5, *Alejandre 596/91* (MA); b_1, *Aldobarandi and Baldini 18777* (MA); b_2, *Herrero et al. 886* (MA); b_3, *Moraldo s.n.*, 9 May 1977 (FI)].

40° 31´ N 2° 45´ W, Aug 1962, *Galiano, E.F. s.n.* (SEV). Huesca: Candasnos, valle de la valcuerna, 41° 30´ N 0° 3´ E, 3 May 1981, *Alamillo, Castroviejo, Fdez. Quirós and Nieto 2410 SC* (MA); Benabarre, unos 2 km al S del pueblo, 42° 5´ N 0° 28´ E, 18 Jun 1987, *Pedrol 1894* (MA); Entre Peñalba y Candasmos, 41° 30´ N 0° 0´ E, 31 May 1981, *Devesa, Luque, T. and Romero, C. s.n.* (SEV); Yebra de Basa. Umbría del Crestón en monte Serraton, 42° 29´ N 0° 17´ W, 28 May 1988, *Montserrat, P. s.n.* (JACA); Castillonroy. Monte Santa Ana, 41° 53´ N 0° 30´ E, 5 Jun 1987, *Montserrat, G. and P. s.n.* (JACA); Caserres de Castillo. Bco. de la Solana de la Pletas. Estopiñan, 42° 1´ N 0° 33´ E, 5 Jun 1987, *Ferrandez, J. Vicente s.n.* (JACA); Carretera de Tolva. Benabarre, 42° 6´ N 0° 29´ E, 2 Jun 1986, *Montserrat, G. s.n.* (JACA); Fonz, 42° 0´ N 0° 15´ E, 26 May 1987, *Montserrat, G. s.n.* (JACA); Torres del Obispo. Graus, 42° 8´ N 0° 22´ E, 1 Jun 1986, *Montserrat, G. s.n.* (JACA); Circo de Pineta. Bielsa, 42° 38´ N 0° 12´ E, 22 Aug 1991, *Montserrat, P. et al. s.n.* (JACA); Puertolas. Castillo Mayor, 42° 33´ N 0° 7´ E, 19 May 1990, *Ferrández, J.V. s.n.* (JACA); Seira, 42° 29´ N 0° 25´ E, 31 May 1992, *Sese s.n.* (JACA); Egea de Turbón, 42° 22´ N 0° 28´ E, 31 May 1992, *Sese s.n.* (JACA). Jaen: Sierra Seca, El Chaparral, 37° 29´ N 2° 23´ W, 23 Jun 1984, *Bruno, C and Urbe Echebarria, P.M. s.n.* (SEV). Lérida: La Segarra, Vilanova de l´Aguda, pr. Ribelles, 41° 53´ N 1° 16´ E, 25 May 2009, *Calvo and Pedrol 3625* (MA); Cubells, 41° 50´ N 0° 57´ E, 22 May 1983, *Pedrol s.n.* (MA); Balaguer, 41° 48´ N 0° 47´ E, 4 May 1985, *Pedrol 429 JP* (MA); La Noguera, vers les Avellanes, Serra del Convent, 38° 37´ N 2° 2´ E, 14 May 1987, *Romo 13868* (BR, C, H, MA, MSB); In Cataluña Occidental, pr. Rocaelaura, 41° 29´ N 1° 8´ E, 2 Jun 1932, *Font Quer s.n.* (GDA); In planitie Conca de Tremp, inter pagos Figuerola et Vilamitjana, 42° 0´ N 0° 56´ E, 16 May 1972, *Greuter 9983* (M); Tuixent, 42° 14´ N 1° 33´ E, 21 Jul 1969, *Silvestre, S. and Valdés, B. 2544/69* (SEV); Oliola, 41° 52´ N 1° 10´ E, 8 May 1985, *Pedrol 241* (MA); Sant Miguel. Isona, 42° 7´ N 1° 2´ W, 4 Jun 1987, *Montserrat, G. s.n.* (JACA); Boixols, Sierra de Baumort, 42° 10´ N 1° 10´ E, 11 Jul 1972, *Bauer and Spitzenberger s.n.* (W). Madrid: Arganda, 36° 58´ N 2° 51´ W, May 1915, *Vicioso s.n.* (MA); Rivas de Jarama, 40° 23´ N 3° 31´ W, 20 May 1919, *Vicioso s.n.* (MA); Carabaña, 40° 15´ N 3° 14´ W, May 1915, *Vicioso s.n.* (MA); Vaciamadrid, 42° 20´ N 3° 38´ W, 2 Jun 1914, *Villar, H. s.n.* (MA); Dehesa de Arganda (Madrid), 40° 16´ N 3° 26´ W, May 1964, *Borja, J. s.n.* (MA, U); Entre Chinchon y Arganda del Rey, 40° 10´ N 3° 26´ W, 9 Jun 1990, *García, M. and Vázquez, F.M. s.n.* (PR); Villaconejos, 40° 6´ N 3° 29´ W, 3 Jun 1976, *Fernández Diez s.n.* (SEV). Murcia: Camino de el Sabinar a Letur, 38° 13´ N 2° 8´ W, 11 Jun 2008, *Gonzalo, R. and Jiménez, A. 1033* (MA); Carretera a Nerpio, próximo a Campa de San Juan, 38° 11´ N 2° 4´ W, 11 Jun 2008, *Gonzalo, R. and Jiménez, A. 1023* (MA). Palencia: Alar del Rey, Barrio San Pedro. Barranco Costana, 42° 39´ N 4° 18´ W, 4 Jul 1987, *Zuñiga and Alejandre, J.A. 677.87* (MA); Astudillo, encinar del monte Astudillo, 42° 11´ N 4° 17´ W, 30 May 1987, *López, C. and Romero Abelló 2* (MA); Alar del Rey, 42° 39´ N 4° 18´ W, Jul 1936, *Losa, M. s.n.* (GDA); Valdeolmillos, quejigar, finca del monte Polanco, 42° 2´ N 4° 24´ W, 13 May 1987, *López, C. and Romero* (MA). Salamanca: La Orbada, 41° 6´ N 5° 29´ W, 8 Jul 1980, *Fernandez Diez, F.J. 296* (G, MA, SEV); Carrascal de Barregas (Salamanca), 40° 58´ N 5° 45´ W, 13 Jun 1956, *Lainz s.n.* (K, W). Segovia: Entre el puente Segoviana (Cuéllar) y el Molino Ladrón (Lastras de Cuéllar), 41° 53´ N 1° 16´ W, 24 May 1998, *Barriego Gonzalez and Gastón Gonzalez s.n.* (MA); Espirdo, La Higuera, 41° 0´ N 4° 3´ W, 21 May 1988, *Garcia Ada 4671* (MA); Roda de Eresma, 41° 1´ N 4° 11´ W, 8 Jul 1989, *Egido and Garcia, R. 6452 RG* (MA); Pradales, 41° 27´ N 3° 41´ W, 6 Jul 1982, *Romero, T. s.n.* (MA); San Cristobal de Cuellar, 41° 23´ N 4° 24´ W, 16 Jun 1990, *García, S. and Vázquez F.M. s.n.* (K, PR). Soria: Quintana Redonda (Soria), 41° 38´ N 2° 37´ W, 12 Jun 1982, *Segura–Zubizarreta, A. 23953* (M, MA); Calatañazor, 41° 41´ N 2° 48´ W, 1 Jul 1964, *Paunero and Galiano, E.F.s.n.* (SEV). Tarragona: In Cataluña Occidental, L Guardia, c. Prades, 41° 18´ N 0° 59´ E, Jun 1932, *Font Quer s.n.* (S). Teruel: Entre Santa Eulalia y Pozondón, km 10, 40° 34´ N 1° 20´ W, 11 Jul 1965, *Paunero, E. s.n.* (MA); Entre Pozondon y Bronchales, 40° 32´ N 1° 32´ W, 11 Jul 1965, *Paunero, E. s.n.* (MA). Toledo: Dos Barrios, 39° 52´ N 3° 29´ W, 22 May 2007, *Gonzalo, R. and De la Estrella 688* (MA); Villatobas, camino a Lillo, borde de cuneta y desmonte, 39° 52´ N 3° 19´ W, 22 May 2007, *Gonzalo, R. and De la Estrella 682* (MA). Valladolid: Encinas de Esgueva, El embalse, Playa del Godo, 41° 40´ N 4° 43´ W, 20 May 1985, *Fernández Alonso 3091* (MA); Castromonte, 41° 46´ N 5° 2´ W, 30 May 1906, *Sennen s.n.* (MA); Finca Casas Nuevas; Quintanilla de Trigueros, 41° 51´ N 4° 38´ W, Jul 1963, *Cruz, G. s.n.* (MA). Valencia: La Yesa, 39° 53´ N 0° 57´ W, Jun 1980, *Mansanet, Currás and Mateo s.n.* (MA). Zaragoza: An der Strabe Daroca–Rueda de la Sierra. Bei der Abzweigung Nach Las Cuerlas. NW der Laguna de Gallocanto, 40°

58´ N 1° 33´ W, 7 May 1997, *Lewejohann and Müller 97–027* (GOET); Malanquilla, entre Tarayuela y La Marcen, 41° 34´ N 1° 51´ W, 21 May 1990, *Zuñiga and Alejandre, J.A. 1806/90* (MA).

Notes: Difference between *S. atlantica* and *S. austroitalica* are addressed under the discussion of the later species. Both species share the hairy adaxial surface of the basal leaf. However, this character is not restricted to these species and is found in other taxa of the subsection as *S. novakii*, *S. pulcherrima* subsp. *crassiculmis*, *S. zalesskii* and *S. dasyphylla*.

What has been called here *S. atlantica* has been traditionally treated as four different species, *S. atlantica*, *S. iberica*, *S. apertifolia* and more recently *S. almeriensis*. Martinovský (1966) described *S. iberica* as a species closely related to *S. atlantica*, from which can be distinguished by its shorter ligules (1–3 *vz.* 3–6 mm long), thinner leaf–blades [(0.35)0.44–0.5(0.65) *vz.* 0.6–1.2 mm in diameter], the dorsal and subdorsal row ending farther to the lemma apex [1:0.68 *vz.* 1:0.55], the basal leaf–blades ribs

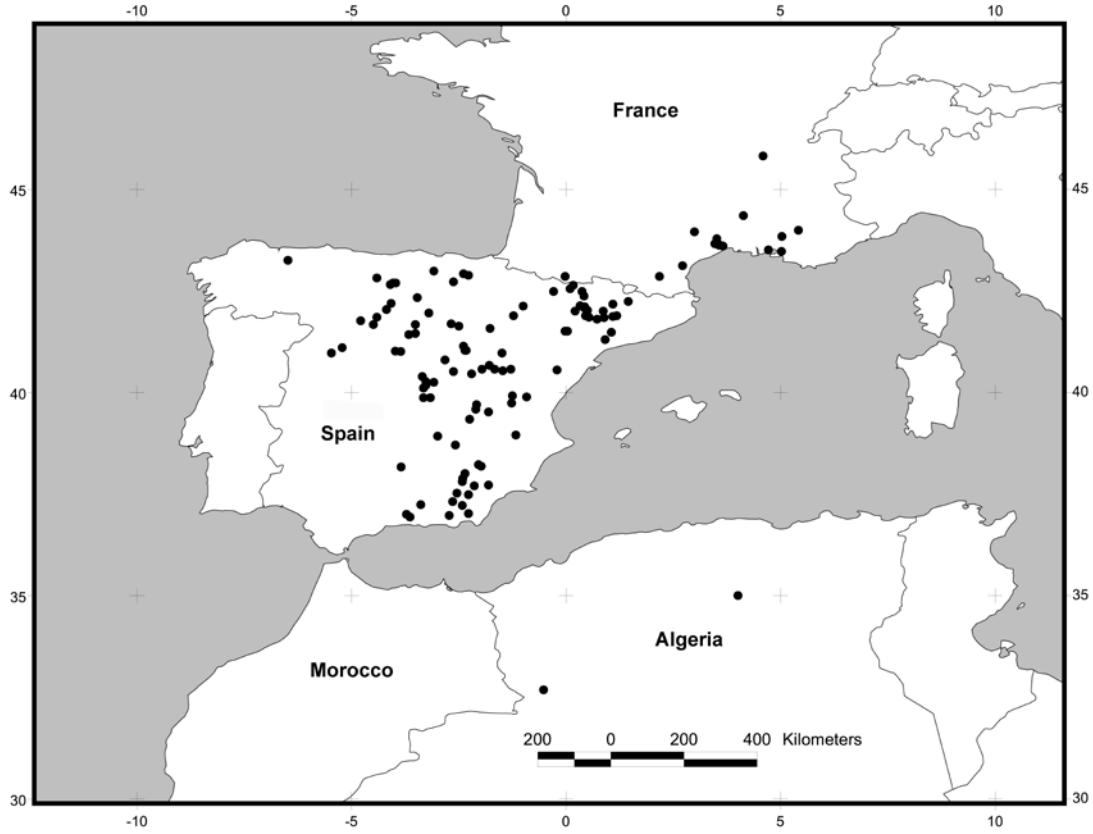

Figure 8. Distribution map: *Stipa atlantica* (●).

quadrangular with the subepidermal sclerenchyma 0.06 mm wide, whereas *S. atlantica* has the basal leaf–blade ribs rectangular and with the subepidermal sclerenchyma 0.3(0.4) mm wide. Likewise, *S. iberica* was originally described from Spain and south France, whereas *S. atlantica* has been considered endemic of the Atlas range of North Africa (Martinovský 1966). Subsequently, Martinovský (1970) recognized the possibility of the presence of *S. atlantica* in south Spain, and Vázquez and Devesa (1996) recognized the presence of *S. iberica* in North West Africa. During the present study, we initially consider both taxa as subspecies. However, a careful examination of specimens, mainly from South and central Spain, shows that most of the specimens of *S.*

iberica shares identical features with *S. atlantica* in the sense of its original description, and consequently both taxa represent small variations of the same species.

Stipa apertifolia was originally described endemic from North Spain and mainly characterized by having the basal leaves scabrous on both surface, the awn with the column scabrous and with scattered soft hairs and the basal leaf apex hairy. More recently Vázquez and Devesa (1996) consider *S. apertifolia* and *S. dasyvaginata* Martinovský the same species. After a thorough study of the Spain material, *S. apertifolia* falls inside the variation of *S. atlantica*. The column ornamentation as well as the hairy basal leaf apex is shared with specimens of *S. atlantica*. In relation to the leaf ornamentation, species intermediate both *S. apertifolia* and *S. atlantica* are found, considering the absence of hairs a small variation of *S. atlantica* occurring in all its distribution area. More recently Vázquez (2006) described *S. almeriensis*, endemic from east Andalusia, and mainly distinguished by having the ventral rows of hairs of the lemma ending before the lemma apex. After the revision of original material cited by Vázquez (2006), most of the specimens exhibit lemmas with the ventral row reaching the top or almost so. Likewise, the remainder characters of *S. almeriensis* are shared with *S. atlantica*.

Throughout its geographic range *S. atlantica* is a morphological plastic species, numeral subspecies, varietal and forms names have been applied to plants of this species (Martinovský 1970; Scholz 1989; Vázquez and Devesa 1996; Romo et al. 1998, Vázquez 2006). This taxon is highly variable in the degree of the pubescence of the adaxial surface of the basal leaves, ranging from scabrous to densely pubescent. Specimens with the basal leaf–blade scabrous on both surfaces have been called *S. iberica* subsp. *austro–iberica* (Scholz 1989). Species with the adaxial surface densely and minutely pubescent have been called *S. apertifolia* var. *nevadensis* (Vázquez and Devesa 1996), while specimens with the adaxial surface scabrous with long hairs near the margin have been called *S. iberica* subsp. *pauneroana* (Martinovský 1970). The abaxial surface is usually distinctly scabrous, but sporadically specimens with the abaxial surface glabrous or somewhat scabrous can be found, which have been recently named *S. iberica* f. *levis* (Martinovský 1970), and more recently raised to subspecific rank as *S. iberica subsp. bolosii* (Romo et al. 1998). Sporadically in SW France and East Spain, specimens with the basal leaf–blade part shortly pubescent (as a prolongation of the leaf–sheath hairs) are found and have been called *S. iberica* f. *pseudodasyphylla*. As well, the size of the plants and its structures have been used for taxa delimitation. Thus, specimens shorter than 30 cm and with thin leaf–blades have been called *S. iberica* var. *pygmae* (Martinovský 1970). All these variability are not consistent enough to distinguish different taxa, as many individuals with intermediate characteristic are encountered and the characters are not correlated with restricted areas or habitat. Therefore all the former names are placed as synonymy of *S. atlantica*.

4. Stipa epilosa Martinovský

Stipa epilosa Martinovský, Preslia 39: 274. 1967; *Stipa pulcherrima* subsp. *epilosa* (Martinovský) Tzvelev, Novosti Sist. Vyssh. Rast. 11: 18. 1974. *Type*: TURKEY. In montis Ak–Dagh, 9 Jul 1889, *Bornmüller 317* (holotype,. B!; isotype JE!)

Herbs 20–64 cm high, perennial caespitose; branching intravaginal. Culms 2–3(4) noded, nodes glabrous, violet or brown; culm internodes scabrous, glabrous or pubescent. Basal leaves 20–64 cm long, green and pruinose (blue appearance); leaf–sheath scabrous, glabrous or minutely pubescent, usually ciliate, cilia (0.21)0.24–0.8(1.1) mm long; leaf–blade 15–49 cm long, (0.4)0.5–1(1.3) mm in diameter, convolute, abaxial surface glabrous or minutely scabrous at the base and the remainder glabrous, adaxial surface totally scabrous or papillae, prickles 0.01–0.04 mm long; ligules (0.5)1–3(3.3) cm long, rounded, acute, obtuse or truncate, scabrous, minutely pubescent or glabrous, usually ciliate or ciliolate, cilia (0.03)0.06–1(1.3) mm long. Floriferous culm leaves 21–50 cm long; leaf–sheath 15–45 cm long, totally scabrous or scabrous or pubescent near the leaf–blade and the margin and the remainder glabrous, margins usually glabrous; leaf–blade 0.7–17.3 cm long, (0.18)0.33–0.71(0.73) mm in diameter, abaxial surface usually glabrous, adaxial surface scabrous, prickles 0.01–0.07 mm long; ligules (0.5)1.5–6.4(9.2) mm long, acute, truncate, obtuse, irregular or rounded, scabrous or pubescent, margins and tip usually ciliate or ciliolate, cilia (0.01)0.02–0.8(1.1) mm long. Panicle 13–44 cm long, contracted, exserted or partially enclosed by the upper leaf–sheath, (3)4–5(6) noded; basal internode 9–36 cm long, scabrous or pubescent; branches (1.3)2.2–4.2(5.6) cm long, patent or ascending, setaceous or minutely setaceous, setae (0.05)0.1–0.83(1.2) mm long; basal nodes with 1–2 branches with 1(2) spikelets each. Glumes subequal, lanceolate, long acuminate, usually glabrous with the central nerve glabrous or ciliate, cilia (0.02)0.2–0.8(1.5) mm long, with the margins and tip hyaline (sometimes with purple stains), the lower (5.1)5.7–8.5(9.4) cm long and 3–6(7) nerved, the upper (4.2)5.1–7.7(9) cm long and 5–7(9) nerved. Anthecium (15)16–22.8(23.9) mm long, (0.8)1–1.5(1.8) mm wide, fusiform, coriaceous, green, brown or pale brown; lemma (11.7)12.2–17.8(18.5) mm long, near the apex glabrous, with 7 rows of hairs, with the dorsal and subdorsal ones fused and the remainder rows free or with 6 rows of hairs with the dorsal row absent, the ventral row reaching or almost reaching the top, the dorsal row measuring 1/3–1/2 the length of the lemma (or absent), the subdorsal rows equal, shorter or slightly longer than the dorsal row, the lateral row always longer than the dorsal and subdorsal row, lemma with patent hairs (0.45)0.5–1.1 mm long; callus (2.7)3.5–5(6) mm long, acute, curved, villous with hairs (1.5)1.9–3(3.4) mm long on the ventral face and (0.9)1–1.7(2) mm long on the dorsal face, scar elliptic, peripheral ring (0.88)0.96–1.28(1.5) mm long, (0.24)0.32–0.44 mm wide (ratio wide/length= (0.27)0.29–0.38); palea (11.3)11.8–17.5(18.1) mm long, lanceolate, margins and tip hyaline, dorsally 2–nerved, between the two nerves papillae or glabrous, margins glabrous and tip usually ciliate, eventually with a dorsal row of hairs 1/4–1/3 the length of the palea, green or brown pale; lodicules 3, equal or subequal, with the dorsal ones slightly longer or shorter than the ventral one,

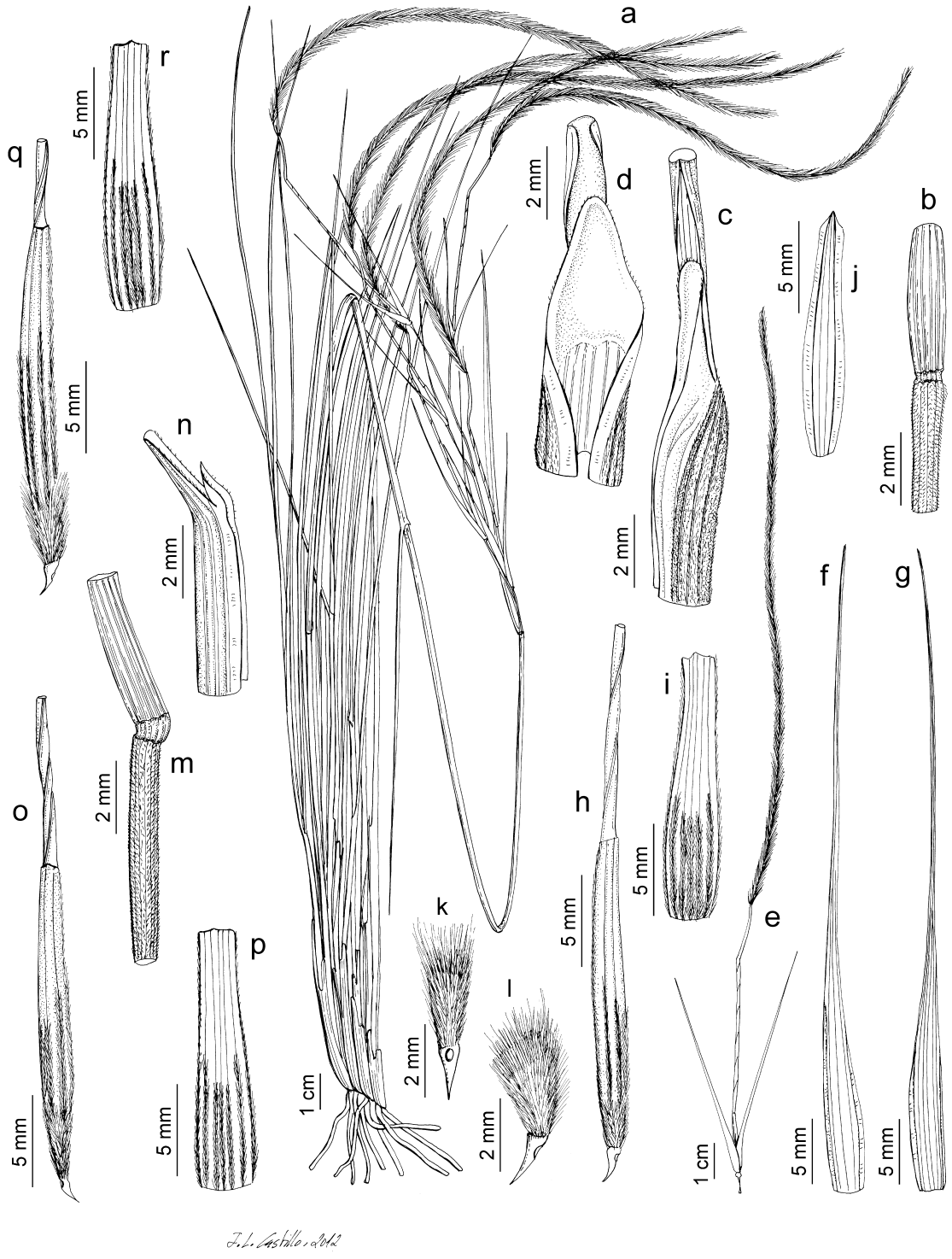

Figure 9. *Stipa endotricha*. A, habit; B, floriferous culm node; C, ligule, lateral view; D, ligule, frontal view; E, spikelet; F, upper glume; G, lower glume; H, anthecium and column; I, lemma; J, palea; K, callus, ventral view; L, callus, lateral view. *Stipa epilosa* subsp. *epilosa*. M, floriferous culm node; N, ligule, lateral view; O, anthecium and column; P, lemma. *Stipa epilosa* subsp. *araxensis*. Q, anthecium and column; R, lemma. [Based on: A–L, *Aedo et al 14212* (MA); M–P, *Cabezas et al. 639* (MA); Q, R *Gabrielan et al. s.n.*, 27 May 1960 (MA)].

acute, lanceolate or linear lanceolate, membranous, glabrous or the dorsal lodicules ciliate at the apex, dorsal lodicules (2)2.7–3.7(4.4) mm long, ventral lodicule (2)2.5–4.1(4.5) mm long. Awn (16.1)22.1–33.5(36) cm long, bigeniculate; column (3.4)4.9–7.9(8.3) cm long, base (0.46)0.58–0.75(0.82) mm in diameter, twisted, brown or brown and green, usually glabrous (rarely scabrous or hairy); geniculation (1.3)1.7–2.5(2.8) cm long, glabrous, scabrous or sparsely pilose; seta (12.7)16.4–26.8(28) cm long, (ratio column length/seta length = (0.24)0.26–0.4(0.45)), flexuous, plumose, hairs in lower part (3.6)4.3–5.8(6.6) mm long. Anthers (6.1)6.9–10.3(11) mm long, usually glabrous, yellow or purple. Ovary glabrous, styles two. Caryopsis 9.2–13.3(14.3) mm long, fusiform; embryo 9.2–13.3(14.3) mm long.

4a. Stipa epilosa subsp. epilosa

Stipa epilosa subsp. *montana* Moraldo, Webbia 40: 258. 1986. *Type:* ITALY. Piemonte. Entracque (Alpi Marittime), M. Lausa alle Gorge, 28 Jun 1983, *Moraldo and Diamanti s.n.* (holotype, FI digital image!; isotype NAP, TO, Moraldo herbaria).
Stipa rigida Martinovský,Preslia 39: 273. 1967, nom. inval. *Type:* ITALY. Valleprieta alla S. Trinita in Lattio, no *author* (holotype, FI)
Stipa turcica Martinovský, Preslia 39: 274. 1967. *Type:* TURKEY. Çcankiri Montes Ilgas Dagh, *Pilat 2179* (holotype, PRC).

Herbs 20–64 cm high. Basal leaf 20–60cm long, green; leaf–sheath scabrous, glabrous or minutely pubescent; leaf–blade 15–49 cm long, (0.4)0.5–0.8(1) mm in diameter, convolute, abaxial surface glabrous or minutely scabrous at the base and the remainder glabrous, adaxial surface scabrous or papillae, prickles 0.01–0.4; ligules (0.5)0.7–3(3.3) cm long. Floriferous culm leaf–blade 21–47 cm long, abaxial surface usually glabrous, adaxial surface totally scabrous. Glumes (4.2)5.4–8(9.4) cm long. Anthecium (15)15.8–20(21.7) mm long, 1–1.3(1.4) mm in diameter. Lemma (11.7)12.1–15.6(16.7) mm long, with 7 rows of hairs, with the dorsal and subdorsal ones fused and the remainder rows free or with 6 rows of hairs with the dorsal row absent. Callus (2.7)3.3–4.6(5) mm long. Awn (16.1)21.5–28.2(33.5) cm long. (Fig. 9 m–p; Fig. 10 b_2)

Chromosome Number: Unknown.

Habitat and Distribution: Inhabits stony slopes (usually limestones and calcareous rocks), open community of *Abies* and *Pinus*, subalpine meadows, and more rarely on serpentine and outcrops of schists, between 100– 2400 m. Subspecies especially frequent at southeast Europe and in Turkey and more sporadically found in East and Central Europe (W France, N Italy and S Switzerland), West Europe (Spain) and at the Caucasus. *Stipa epilosa* subsp. *epilosa* has also been reported from the Dagestan mountains (Iran and Turkmenistan), but has been impossible to examine the material supporting these records. (Fig. 11).

Phenology: Flowering and fruiting from May to August.

Representative Specimens Examined: ALBANIA. Gjirokastër: Mali Lunxheris, N–Hánge, 40° 8´ N 20° 41´ E, 13 Jul 1980, *Krendl s.n.* (C, W); Kuruna supra Vonicko distr. Ljaskovik, 40° 5´ N 20° 31´ E, 9 Jul 1896, *Baldaci 477* (G); Kreis KorÇa: Mali Thate, 40° 11´ N 19° 55´ E, 17 Jul 1980, *Krendl s.n.* (W).

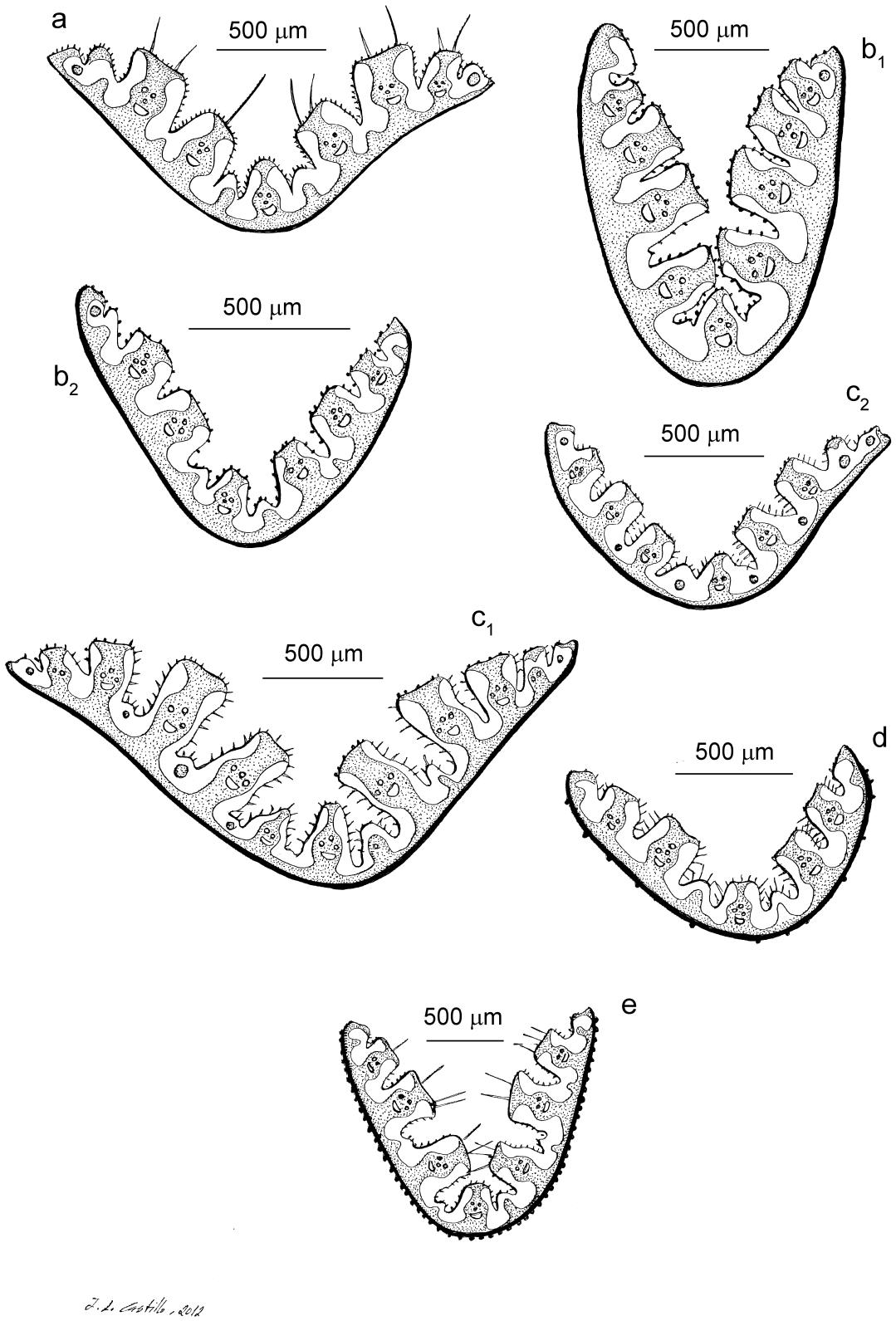

Figure 10. Transverse section of leaf–blades: a_1, *Stipa endotricha*; b_1, *S. epilosa* subsp. *araxensis*; b_2, *S. epilosa* subsp. *epilosa*; c_1, *S. eriocaulis* subsp. *eriocaulis*; c_2, *S. eriocaulis* subsp. *lutetiana*; d, *S. dasyvaginata*; e, *S. novakii*. [Based on: a_1, *Aedo et al. 14212* (MA); b_1 *Gabrielan et al. s.n.*, 27 May 1960 (MA); b_2, *Cabezas et al. 639* (MA); c_1, *Berger 19935* (BR); c_2 *Bullemont s.n.*, 9 Jun 1867 (BR); d, *Herrero et al. 3206* (MA); e, *Calvo et al. 925* (MA).]

Shkodër: Kreis Shkodra: Velecikut, 42° 21´ N 19° 31´ E, 22 Jul 1980, *Krendl. s.n.* (C, W). ARMENIA Syunik': In rupbestribus Bergt dagh, 39° 18´ N 46° 9´ E, 9 Aug 1865, *Haussknecht s.n.* (JE, W). AUSTRIA. Lower Austria: Austria inf, Hainburg in pascuis siccis montis Pfaffenberg, 48° 9´ N 16° 56´ E, 8 Jun 1944, *Rothmaler 20144* (JE). BOSNIA AND HERCEGOVINA. In saxosis m Hum prope Trebinje, 44° 5´ N 17° 59´ E, Jul 1886, *Vandas s.n.* (PR); In saxosis m. Glogovo pr. Jablanica, 43° 33´ N 17° 46´ E, Aug 1889, *Vandas s.n.* (PR); Na ceste k Orrenske lokre, 44° 17´ N 18° 59´ E, 16 Aug 1886, *Vandas, K. s.n.* (PR). BULGARIA. Pernik: Golobørdo, SO for Pernik, 42° 33´ N 23° 4´ E, 6 Jun 2002, *Thornberg s.n.* (C); Montes Konjavska planina, 42° 38´ N 22° 53´ E, 23 May 1994, *Thornberg s.n.* (BR). Smolyan: Rhodopes Centrales. Buynovsko Gorge, 41° 38´ N 24° 20´ E, 2 Jul 2004, *Navarro et al. 4841* (MA); Rhodopes Centrales. Camino del lago Chairite a Trigrad, 41° 36´ N 24° 22´ E, 2 Jul 2004, *Navarro et al. 4940* (MA). Varna: Coastal area of Black sea, ca. 10 km W of Varna. Pobiti kamani E of Povelyanova, 43° 13´ N 27° 42´ E, 5 Jun 1998, *Uzunov, Gussev and Vitek 98–320* (W). CROATIA. Spplit Dalmatia: Scoglien Bacili (Lukavci) zwischen Lesina und Curzola: Grosserer Scaglio, 42° 57´ N 17° 8´ E, 22 May 1911, *Ginzberger and Teyber s.n.* (W). Zadar: Scoglien westl. v. Lagosta: Mali Razanak, 44° 18´ N 15° 19´ E, 29–30 May 1911, *Ginzberger and Teyber s.n.* (W). FRANCE. Bourgogne: Fort de l´Ecluse, 47° 20´ N 4° 53´ E, 25 May 1987, *Jaquemond 3529* (S). Provence–Alpes–Côte d'Azur: Charena pres Gap, 44° 34´ N 6° 5´ W, 14 Jun 1885, *Girdo s.n.* (G); Le col de Braus prés de Nice, 43° 44´ N 7° 14´ E, 27 Jun 1863, *Ayoisse s.n.* (G); Chateau d´Oex (canton de Vand), 44° 28´ N 7° 8´ E, Jul 1860, *Leresche s.n.* (JE); Alpes Maritimes, an der Strabe Tende zum Tunnel nach Limonse, bei der neuen Eisenbahnbrücke, 44° 5´ N 7° 35´ E, 18 Jun 1980, *Lippert 17172* (MSB). Limousin: M Algren: La Garda sur Charana pré Gaps, 46° 15´ N 2° 6´ E, 5 Jul 1863, *Gariod s.n.* (G). Rhône–Alpes: Dept. Savoie: TrockenhÇange kurz oberhalb Lanslevillard an der Strabe zum Col de Iseran, 45° 25´ N 7° 2´ E, 18 Aug 1970, *Merxmuller and Zollitsch 26494* (M); Savoie, 45° 24´ N 6° 30´ W, 18 May 1894, *Pitard s.n.* (NY). GREECE. Anatolikí Makedonía kai Thráki: Thrakien: ca. 1 km N Avas, gegen den Suzuz tepe, SW–Hang, 40° 56´ N 25° 55´ E, 25 May 1979, *Krendl s.n.* (W); Peninsula Hagion Oros. M Athos: Stralidvehi, 40° 15´ N 24° 15´ E, 2 Jul 907, *Halácsy 907* (BR, G, JE, W, WU); Nomos Kavala. Pangeon Oros, Hänge des Hauptgipfels (Pilaf Tepé), 40° 55´ N 24° 5´ E, 20 Jun 1985, *Lippert 20630* (C, M); Ad fines prov. Kavala et Serres: in montis Pangeo ditios Deven Karan, 40° 55´ N 24° 6´ E, 17 Jul 1978, *Greuter 16013* (C, MA). Attica: Mt. Cithaeron, 38° 11´ N 23° 14´ E, 15 Jun 1930, *Guiol 1252* (UPS); Anavryta Estate, oot of Mt Pendelikon near Athens, 38° 4´ N 23° 53´ E, May 1861, *Leutwin de Fellenberg s.n.* (U). Central Greece: Stera Ellas. Prov. Fokidos. Distr. Doridos. Mt. Ghiona, 38° 37´ N 22° 16´ E, 12 Aug 1980, *Baden, Franzén and Strid 984* (C); In montis Oeta (nunc Katavothra) Phthiotidis, 38° 49´ N 22° 17´ E, 10 Jul 1879, *Heldreich s.n.* (G, W); Dirphys gebergete (Euboea), 38° 38´ N 23° 50´ E, 18 Jun 1969, *Fokkinga s.n.* (L). Central Macedonia: prov. Serres et Dhrama: mons Orvilos, in latere merdional verticis principis usque ad cacumen, 41° 22´ N 23° 37´ E, 21 Aug 1978, *Greuter 14073* (C); Bistrapol, S of Mavorov. 3 Km E of the road Mavorov–Galičnik, 40° 39´ N 20° 43´ E, 17 Jul 1984, *Froten_olsen, 6480* (G, LD, MA). East Macedonia and Thrace: Kouri, Mt. Falakron (Drama, Gr.), 41° 19´ N 24° 0´ E, 6 Jul 1993, *Bouharmont 23851* (BR). Epirus: Nom. Ioanninon, Ep. Dhodhonis: Mt. Tomaros (Olitsikas), S ridge W of the village Kriovrisi, 39° 42´ N 20° 56´ E, 13 Jul 1979, *Hartvig and Christiansen 7975* (C); E slope of Tymphi Mts between Tsepelovon and Brisogorion, 39° 54´ N 20° 49´ E, 14 Jun 1977, *Mennega and Driehuis 201* (U); Monte Peristeri (cadena Lakmos), 39° 41´ N 21° 7´ E, 30 Jun 2007, *Castroviejo et al. 18411* (MA); Ioánnina: pista Elatochori–Vorousa, al NW Elatochori, montes Karababas, 39° 53´ N 21° 0´ E, 29 Jul 2007, *Cabezas et al. 639* (MA). Ionian Islands: Insel Kérkira (Nom. Kerkiras). Pandokrátoras, 39° 44´ N 19° 51´ E, 16 May 2000, *Gutermann et al. 34994* (W, WU). Peloponesse: Lakonias, Ep. Lakedemonos, Mt. Taigetos. Near EOS katafigion NE of Profitis Ilias, 36° 58´ N 22° 22´ E, 30 May 1991, *Strid et al. 33011* (C); Likouria, 37° 15´ N 22° 48´ E, 4 Jul 1975, *Nydegger s.n.* (G); Achai, in montis Chelmos (Aroania), 37° 57´ N 22° 13´ E, 25 May 1926, *Bornmüller 1581* (G, JE, PR, S). Thessaly: Trikala: Mt. Boutaia, 3 km SSW of Chalikion, 39° 41´ N 21° 11´ E, 11 Jul 1973, *Aldén 3427* (C); Chaliki: Turnara in mte Salatura, 39° 40´ N 21° 8´ E, 26 Jun 1896, *Dörfler 843* (W). Voreío Aigaío: Nom. and Ep. Serron: Mt Menikion, SW part, c. 5,5 km NE of the village of Inoussa (Above the hamlet of Chionochorion), 38° 31´ N 26° 14´ E, 23 Jul 1979, *Strid and Papanicolau 15805* (C). West Macedonia: Grevenos/Nom. Kozanis, Ep. Voiou: Mt. Vourinos, 40° 11´ N 21° 40´ E, 26 Jul 1979, *Hartvig and Christiansen 8477* (C); Montes Timfi: in ascensu a lacuna media ad lacum Dhrakolimni, praesetim in latere boreali montis Ploskos, 39°

58´ N 20° 48´ E, 23 Jul 1977, *Greuter et al. 15055* (C, G). HUNGARY. Budapest: Budae–Pestini; in montibus Aquinci, 47° 34´ N 19° 4´ E, 4 Jun 1897, *Borbás s.n.* (W). Tolna: Hungaria austro–oirientalis, comitatus Krassó–Szörény, Herkulesbad, in m. Vrf. Suskului, 46° 11´ N 18° 38´ E, 24 Jun 1905, *Lindberg, H. s.n.* (H). ITALY. Abruzzo: ca. 2–3 km S von Prezza, gegen die Station Anaversa, am Cle tre Tombe, 42° 3´ N 13° 49´ E, 1 Jun 1978, *Burri and Krendl s.n.* (W). Piemonte: Prov. Cuneo; Val Maira, 2 km westlich Cucchiales an der Strabe vaon Stroppo zum Colle di Sampeyre, 44° 34´ N 7° 11´ E, 4 Aug 1972, *Podlech and Lippert 11697* (M); Alpi Marittime: ca. 2–3 km E Limone unterhalb der Casali Braia, 44° 12´ N 7° 34´ E, 27 Jun 1982, *Burri and Krendl s.n.* (W); Alpes: Commune di Streppe westlich Cuneo Gebiete des Monte Bettone, 44° 33´ N 7° 5´ E, 6 Jul 1976, *Metlesics s.n.* (W). Trentino Alto Adige: Colli aridi sopra Tarces. Val Venosta, 46° 38´ N 10° 47´ E, 16 Jun 1985, *Kiem s.n.* (M). Valle d´Aosta: Red cliffs at the edge of St. Vincent, beside to road to Montjovet, 45° 43´ N 7° 40´ E, 1 Jun 1999, *Müller 6758* (JE); Grajischen Alpen. Gran Paradisso–Massiv Val Grauson (N Cogne), 45° 37´ N 7° 21´ E, 20 Jul 1992, *Hörandl and Hadaček 4427* (W). KOSOVO: Bertiscus (Alpes borealis albanicae): In fauce fluvil Pećska Bistrica prope oppidum Peć (Ipek), 42° 42´ N 20° 16´ E, 3 Jul 1933, *Rechinger fil. and Scheffer 120* (S); Kućište pr. Pec, 42° 41´ N 20° 4´ E, Aug 1914, *Vandas s.n.* (PR); In lapid m. Suha planina prope Drzilovo, 42° 51´ N 20° 38´ E, 27 Jul 1922, *Vandas s.n.* (PR). MACEDONIA. Central Macedonia: In saxosis calcareis inter Rosždan et Allchar, 41° 9´ N 21° 56´ E, *Dörfler 393* (JE, W). Viora, bei Vodena, 40° 48´ N 22° 2´ E, 23 May 1905, *Halácsy 971* (WU). Polog: Scardus in lapidosis montis Kobilica, 42° 5´ N 20° 53´ E, 31 Jul 1890, *Dörfler s.n.* (WU). Pelagonia: Distr. Almopia: montes Kožuf, in latere austro–or montis Tzena supra pagos Periklia et Lagadhia, 41° 9´ N 22° 10´ E, 30 Jul 1976, *Greuter 14073* (C); Prilep, NE von Pletvar, vom Kozjak am Kamm gegen Krstec, 41° 24´ N 21° 20´ E, 4 Jul 1977, *Krendl s.n.* (W). Skopje: Treska–Schlucht bei Skopje, nördlich und südlich der Staumauer, 42° 0´ N 21° 26´ E, 9 May 1968, *Bäbler and Quasdorf 417* (B); Westhang am Petrina bei Skopje, 42° 0´ N 21° 26´ E, 17 May 1968, *Bäbler and Quasdorf 569* (B). Southwestern Macedonia: Montes Galicica supra jugum viae Trpejca–Stenje, 40° 55´ N 20° 50´ E, 9 Jul 1976, *Greuter 13878* (G); Distr. Almopia: montes Kozuf, in latereaustro–or montis Tzena supra pagos Periklia et Langadhia, 40° 55´ N 20° 50´ E, 30 Jul 1976, *Greuter s.n.* (G); Ort: Ohridsee W. seite bei Kalishta, 41° 1´ N 20° 43´ E, 28 May 1971, *Breckle 1403* (W); Ohrid, von Pestani zum Gogo, 41° 0´ N 20° 48´ E, 15 Jul 1977, *Krendl s.n.* (W). MONTENEGRO. Route de Cetinje a Njegus, 42° 23´ N 18° 55´ E, 25 Jun 1897, *Saint Lager s.n.* (G, GH, NY). ROMANIA. Mehedinti: Vîrciorova, 44° 43´ N 22° 29´ E, 2 May 1967, *Negrean s.n.* (L, M); Aud dem Berge Suškuluj bei Herkulesbad im banata, 44° 52´ N 22° 24´ E, 1 Jul 1902, *Richter 313* (C, G, H, L, MA, NY, PR, WAG). SERBIA. Pirzren: Sar–Planina bei Tetovo, Ostanhänge oberhalbe des Sporthotels, 42° 5´ N 20° 50´ E, 20 Aug 1973, *Podlech and Lippert 26197* (G, MSB); Zlatibor: Tara–Gebirge, ca. 1 km N Kremna, 43° 50´ N 19° 34´ E, 30 May 1992, *Krendl s.n.* (W). Zajecar: In saxosis Strbac (Serbia Oriental), 43° 30´ N 22° 19´ E, May 1872, *Pancic s.n.* (W). SLOVAKIA. Banská Bystrica: Bei Bôrka, 48° 38´ N 20° 46´ E, 20 Jul 1977, *Feige s.n.* (B). SPAIN. Castellon: Peñagolosa (CS), 40° 13´ N 0° –21´ W, 9 Jun 1999, *Jiménez, J. et al 16* (MA). Cuenca: Mogorrita. Montes Universales, 40° 20´ N 1° 46´ W, 22 Jul 1979, *López, G. 2101* (MA). Granada: Sierra Seca: El Chaparral, 37° 11´ N –3° –55´ E, 29 Jun 1988, *Valdés et al. 2657/88* (SEV). Lérida: S von Tremp: Sierra de Montsec, ESE von Cellers, Weg zur Kapelle Sant Salvador de Bosc, 42° 1´ N 0° 56´ E, 24 May 2003, *Vitek 03–0071* (W). SWITZERLAND. Graüdunden: Oberengadin, Zwischen Samaden u. Celerina; bei Cristolais, 46° 31´ N 9° 51´ E, 4 Aug 1991, *Adler s.n.* (W). Valais: Ausserberg w Brig, 46° 19´ N 7° 59´ E, 18 May 1975, *Nydegger s.n.* (S); Grazige, droge Z. helling, Zmutt, ten zuidwesten van Zermatt, 45° 58´ N 7° 35´ E, 19 Jul 1964, *MCG s.n.* (WAG); Vrad, Château d´Oex, 46° 28´ N 7° 8´ E, 1863, *Severin Axel s.n.* (S, UPS). TURKEY. Bitlis: Soghuk Punar bei Amassia, 38° 20´ N 41° 47´ E, 14 May 1892, *Manissadjian s.n.* (M, NY). Ekisehir: 5,8 km S Eskisehir an der Strabe nach Akpinar köyü knapp unterjalb N des Passes, 39° 46´ N 30° 31´ E, 10 Jun 1969, *Buttler 13407* (M). Erzincan: Oltu 7 km w Sihsor, 39° 18´ N 38° 37´ E, 26 Jun 1988, *Nydegger 43492* (G). Erzurum: Gipfel des Akdagh nordlich Amassia, 40° 35´ N 41° 46´ E, 19 Jul 1892, *Freyn 543* (M); Sakaltutan Geçidi, Erzincam, 39° 52´ N 39° 7´ E, 2 Jul 2001, *Aldasoro et al. 2676* (MA). Gümüshane: Carretera entre Gümüshane y Bayburt, cerca de 1,4 km antes del cruze para Kale, 40° 22´ N 39° 40´ E, 26 Jun 2001, *Sara Nisa et al. 625* (MA). Mersin: Iter Cilicicum in Tauri alpes "Bulgar Dagh" Prope montem Gisyl Deppe, 37° 15´ N 34° 20´ E, 21 Jul 1853, *Kotschy 227* (C, G, MEL, PR, S, W, WAG). UKRAINE. Krym: Ascent Nikitskaya yayla from Yalta side, 44° 30´ N 34° 10´ E, 18 Jun 1947, *Prokudin s.n.* (LE).

RUSSIA Kabardina Balkaria: Caucasus: Tyrnyauz, regio montis Elbrus, in valle fluminis Adylsu, prope pagum Elbrus, loco Dzhan Tugan dicto., 43° 25´ N 42° 55´ E, 23 Jun 1980, *Vašak s.n.* (W).

4b. ***Stipa epilosa subsp. araxensis*** *(Grossh.) R. Gonzalo. comb nov.*

Basion.: *Stipa araxensis* Grossh., Beih. Bot. Centralbl., Abt. 1, 44: 200. 1928; *Stipa pulcherrima* subsp. *araxensis* (Grossh.) Tzvelev, Novosti Sist. Vyssh. Rast. 11: 18. 1974; *Stipa pennata* var. *araxensis* (Grossh.) Freitag, Notes Roy. Bot. Gard. Edinburgh 42(3): 441. 1985; *Type:* ARMENIA. Transcaucasia, Nakhichevan distr., inter Negram et Darosham, 16 v 1923, *Grossheim s.n.* (holotype, TGM?)

Herbs 27–57 cm high. Basal leaf 31–64 cm long, green, pruinose (blue appearance); leaf–sheath scabrous with sparsely hairs or minutely pubescent; leaf–blade 27–49 cm long, 0.6–1.3 mm in diameter, convolute, abaxial surface glabrous or minutely scabrous at the base and the remainder glabrous, adaxial surface scabrous or papillae, prickles 0.01–0.4; ligules 1.5–2.9 cm long. Floriferous culm leaf–blades 4–7.7 cm long, abaxial surface usually glabrous, scabrous or with sparsely stiff hairs, adaxial surface totally scabrous. Glumes 6–9 cm long. Anthecium 20.3–24 mm long, 0.8–1.7mm in diameter. Lemma 15.5–18.5 mm long, with 7 rows of hairs, with the dorsal and subdorsal ones fused and the remainder rows free. Callus 4.8–6 mm long. Awn 28–36 cm long. (Fig. 9 q–r; Fig. 10 b_1)

Chromosome Number: Unknown.

Habitat and Distribution: Inhabits steppes, rocky slopes of middle mountains belt, between 1800–2100 m. From Transcaucasia, and also one sheet described from the province of Kars (Turkey). Also cited from Iran (Tzvelev 1976; Scholz 1985), but unfortunately no specimens from Iran belonging to subsp. *araxensis* has been examined. (Fig. 11)

Phenology: Flowering and fruiting from Jun to August

Representative Specimens Examined: ARMENIA. Kotayk: Ad lacum Sevan, prope pag. Schordsha, 40° 30´ N 45° 29´ E, 23 Jul 1929, *Smirnow 84* (H, JE); Gegharkunik: The southern shore of lake Sevan–Giuney. Village Artanshi near the village Dzhil, 40° 27´ N 45° 27´ E, 19 Aug 1964, *Akhvirdov s.n.* (W). Vanadzor: Vayotsdzor prov.; Yeghegnadzor distr. c. 9 km S Yeghegnadzor, around village Gnishik, 45° 17´ N 39° 40´ E, 26 Jun 2002, *Fayvush et al. Optima Iter XI 2172* (M, W). TURKEY. Kars: Prov. Kars, distr. Kaghyzmay. In suelo lapidosis Demir–Kary, 40° 43´ N 43° 38´ E, 2(15) Jun 1913, *Woronow 12595* (W).

Notes: Stipa epilosa is characterized by having the adaxial surface of the leaf–blades (basal and floriferous culm) completely scabrous. However the abaxial surface and the basal leaf–sheath show some variability. The abaxial surface is usually completely glabrous, but specimens minutely scabrous close to the leaf–sheath and the remainder glabrous are found in its whole distribution area, and the basal leaf–sheath can be indistinctly glabrous or minutely pubescent. *Stipa epilosa* resembles and can be confused with *Stipa eriocaulis*, especially in specimens of Central Europe. Both taxa are similar in most of the characters, but as difference as *S. epilosa*, *Stipa eriocaulis* exhibit the adaxial surface of the leaf–blade with scabrous ribs and the furrows minutely pubescent and the floriferous culm leaves can also be completely pubescent, whereas *S.*

epilosa always has the adaxial surface of all the leaf–blades completely scabrous. But sometimes this difference is not so notorious at the basal leaf–blade, because in *S. eriocaulis* the hairs do not appear until the half of the leaf length. Therefore, the importance of a thorough examination at different points of the leaf, as well as looking the floriferous culm leaves.

The different habitats and altitudinal range made *Stipa epilosa* highly variable, especially what concern the size of the spikelets. Martinovský (1967) described *Stipa turcica*, endemic of Turkey, characterized by having smaller spikelets. More recently Moraldo (1986) described *Stipa epilosa* subsp. *montana*, endemic of Italy, and mainly distinguished from subsp. *epilosa* by having shorter lemmas 19–21 *vz.* 15–18(19) mm long, shorter awns 280–310(320) *vz.* 230–280 (290) cm long, longer basal–leaf ligules 0.5–1 *vz.* 1.5–3 mm long, leaf–sheaths pubescent and the column scabrous, whereas subsp. *epilosa* exhibit glabrous leaf–sheath and column. The difference in size of the spikelets could be associate with the high variation of altitudinal range of the taxa. Whereas the characters mentioned above for *S. epilosa* subsp. *montana* appears throughout the range of the species and cannot be correlated with different habitat or neither geographically distinct.

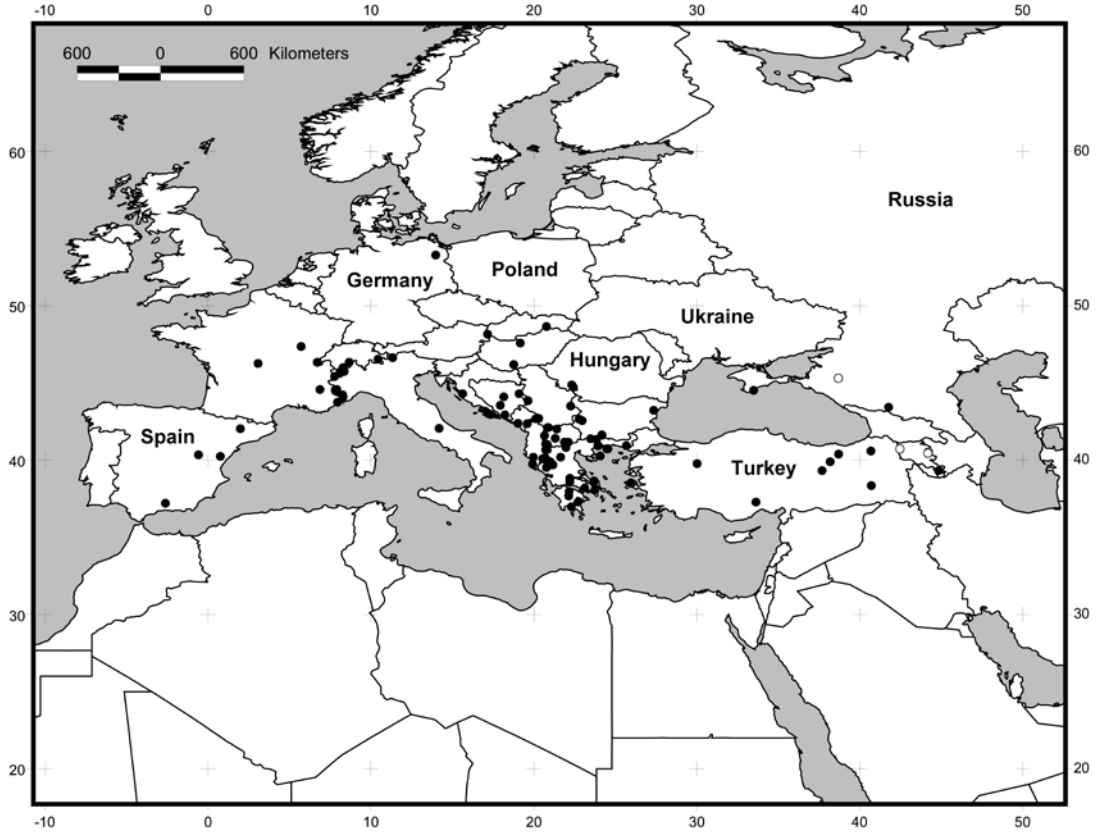

Figure 11. Distribution map: *Stipa epilosa* subsp. *epilosa* (●); *S. epilosa* subsp. *araxensis* (○).

A bluish green coat form was named *S. araxensis* by Grossheim (1928). This taxa has been reduced to subspecies (Tzvelev 1976) or variety (Freitag 1985) of *S. pulcherrima*. However at difference of *Stipa pulcherima*, *S. epilosa* subsp. *araxensis* exhibit the basal leaf as well as *S. epilosa* subsp. *epilosa*, with the only difference of the

bluish green coat. Therefore *S. araxensis* is combined as a new subspecies of *S. epilosa*, and restricted to the Caucasus.

5. Stipa novakii Martinovský

Stipa novakii Martinovský, Feddes Repert. 73: 147. 1966. *Type:* SERBIA. supra fluminis Ibar ripam dextram contra vicum Bogutovac dictum non procul urbe Kraljevo, 19 May 1926, *Novák s.n.* (holotype, PR, digital image !).
Stipa rechingeri Martinovský in Preslia 44: 10. 1972. *Type:* GREECE. Epirus. Distr. Joanina Montes Pindus: In monte Tsuka Rossa ditionis pagi Vovousa (Viosa) 1–2 Aug 1956, *Rechinger s.n*. (holotype, W; isotype, MA).

Herbs 24–49 cm high, perennial caespitose; branching intravaginal. Culms 2–3(4) noded, nodes glabrous, violet or brown; culm internodes pubescent or scabrous. Basal leaves 20–48 cm long, green; leaf–sheath minutely scabrous or minutely pubescent, margin glabrous or ciliate, cilia 0.12–0.61 mm long; leaf–blade 15–39 cm long, (0.49)0.55–0.76(0.86) mm in diameter, convolute, abaxial surface distinctly scabrous, adaxial surface scabrous, papillae or scabrous with scattered hairs (more rarely completely pubescent with the furrows papillae), prickles or papillae 0.01–0.03 and hairs (0.22)0.3–0.5(0.55) mm long; ligules (0.4)0.7–1.9(2) cm long, rounded, obtuse or truncate, scabrous (rarely minutely pubescent), ciliolate or ciliate, cilia (0.01)0.02–0.3(0.45) mm long. Floriferous culm leaves 20–38 cm long; leaf–sheath 12–23 cm long, scabrous, papillae (rarely glabrous or pubescent), margins usually glabrous; leaf–blade 4–16 cm long, (0.2)0.4–0.7(0.8) mm in diameter, abaxial surface scabrous, glabrous or with sparsely stiff hairs, adaxial face scabrous, papillae or scabrous with scattered hairs, hairs 0.4–0.49 mm long; ligules (0.92)1.4–5.1(7.7) mm long, acute or obtuse, scabrous or pubescent, margin and tip usually ciliate, cilia (0.07)0.12–0.65(0.7) mm long. Panicle 15–40 cm long, contracted, exserted or partially enclosed by the upper leaf–sheath, 3–5 noded; basal internode (9)14–28(32) cm long, pubescent or scabrous; branches (0.9)1.7–3(4) cm long, patent or ascending, setaceous, setae (0.1)0.29–0.89(0.94) mm long; basal nodes with (1)2 branches with 1(2) spikelets each. Glumes subequal, lanceolate, long acuminate, glabrous (rarely scabrous when the glumes becomes acuminate) or with the central nerve ciliate, cilia (0.01)0.2–1(1.3) mm long, usually green with the margins and tip hyaline, the lower (4.1)4.5–5.8(6.2) cm long and 3–7 nerved, the upper (3.9)4.2–5.3(5.7) cm long and 5–7 nerved. Anthecium (14.5)14.9–18(18.3) mm long, (0.8)0.9–1.3(1.4) mm wide, fusiform, coriaceous, green, brown or pale brown; lemma (11.3)11.4–14(14.4) mm long, near the apex glabrous, with 7 rows of hairs, with the dorsal and subdorsal ones fused and the remainder rows free, or with 6 rows of hairs with the dorsal row absent, the ventral row reaching the top, the dorsal row measuring 1/4–1/3 the length of the lemma or absent, the subdorsal rows equal or longer than the dorsal row and the lateral rows always longer than the dorsal and subdorsal row, lemma with patent hairs (0.47)0.55–0.81(0.92) mm long; apex glabrous; callus (2.7)3.2–3.9(4.3) mm long, acute, curved, villous, hairs (1.5)1.7–2.5(2.6) mm long on the ventral face and (1)1.1–1.7(1.8) mm long on the dorsal face, scar elliptic, peripheral ring

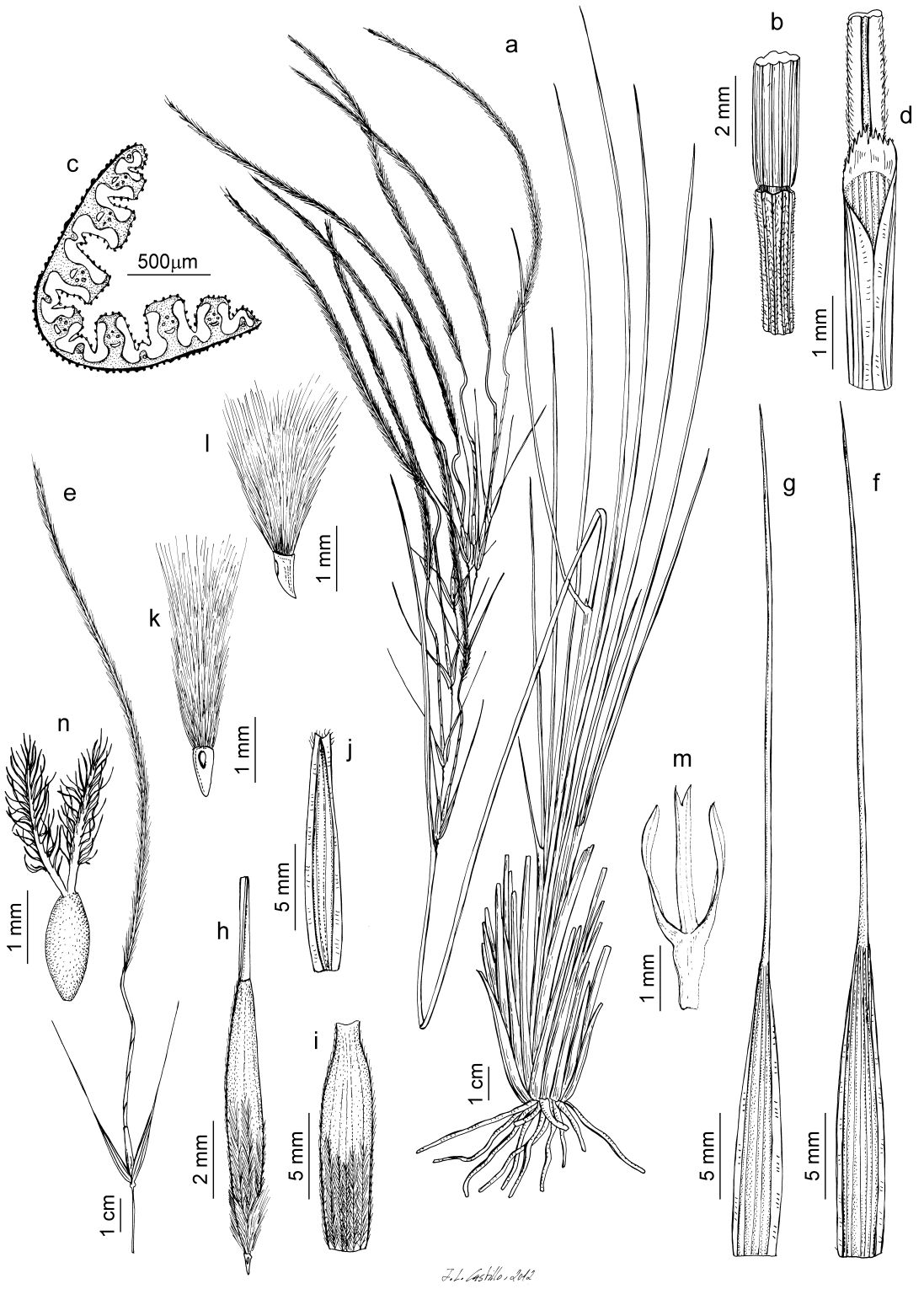

Figure 12. *Stipa novakii*. A, habit; B, floriferous culm node; C, transverse section of leaf–blade; D, ligule, frontal view; E, spikelet; F, upper glume; G, lower glume; H, anthecium and column; I, lemma; J, palea; K, callus, ventral view; L, callus, lateral view; M, lodicules; N, ovary and styles. [Based on: *Calvo et al. 925* (MA).]

(0.88)0.91–1.2(1.3) mm long, (0.27)0.3–0.38(0.41) mm wide (ratio wide/length= (0.27)0.28–0.37(0.4)); palea (10.3)11.3–14.1(14.3) mm long, lanceolate, margins and tip hyaline, dorsally 2–nerved, between the two nerves papillae or glabrous, margins glabrous and tip usually ciliate, sometimes with a dorsal row of hair up to 1/2–3/4 the length of the palea, green or brown pale; lodicules 3, equal or subequal, with the dorsal ones slightly longer or shorter than the ventral one, acute, lanceolate or linear lanceolate, membranous, glabrous or the dorsal ones ciliate at the apex, dorsal lodicules (2.4)2.6–3.6(4.5) mm long, ventral lodicule (2)2.4–3.7(4.9) mm long. Awn (17.3)17.5–23(24.8) cm long, bigeniculate; column (3.8)4.1–5.6(6.1) cm long, base (0.48)0.51–0.66(0.7) mm in diameter, twisted, brown or brown and green, glabrous (rarely minutely scabrous); geniculation (1.3)1.5–2(2.1) cm long, scabrous, glabrous or scattered pilose; seta 13(13.5)18.1(20) cm long, (ratio column length/seta length = (0.24)0.27–0.36(0.39)), flexuous, plumose, hairs in lower part (3.6)3.7–5.5(5.7) mm long. Anthers (5)6.6–9.6(10) mm long, glabrous or with scattered hairs, yellow or purple. Ovary glabrous, styles two. Caryopsis (8.3)8.5–10.2 mm long, fusiform; embryo 1.3–2.1(2.2) mm long. (Fig. 12; Fig. 10 e)

Chromosome Number: Unknown.

Habitat and Distribution: Inhabits serpentines from the tail of the mountain up to the mountain peak, 800–2200 m. Endemic from Greece and southern Serbia. (Fig. 13).

Phenology: Flowering and fruiting from June to August.

Representative Specimens Examined: GREECE. Fthiotida: Sterea Ellas. Iti–Massiv, Aufsteig von Neochorion zum Berg Petrotos 38° 50´ N 22° 14´ E, 19 Jun 1982, *Hagemann, Scholz and Schwarz s.n.* (JE). Grevena: Palaiokastro, Mts. Vourinos. 40° 11´ N 21° 38´ E, 1 Aug 2007, *Cabezas et al. 840* (MA); In latere boreo–orientali verticis Kakoplevri (salatoura) montis Lavadhi (Milea) 39° 49´ N 21° 25´ E, 14 Aug 1974, *Greuter, Charpin and Bernardi AC 11067 WG 12228* (C, H, M); Grevenos/Nom. Kozanis, Ep. Voiou: Mt. Vourinos, 17 km SW of Kozani 40° 11´ N 21° 40´ E, 5 Jul 1977, *Hartvig and Christiansen 6461* (C); Nom. and Ep. Grevenon: N. Pindos, Lingos range, ridge W of Perivoli 39° 36´ N 20° 44´ E, 5 Jul 1978, *Møller and Peterson 1219* (C); Montes Pindus: In declivibus montes Aphtia, in valle Arkudolaka (Valea Kalda) ditionis pagi Perivoli 39° 58´ N 21° 6´ E, 30–31 May 1956, *Rechinger, K.h. 18469* (C, MA, W, WU). Ioannina: Metsovo, puerto de Katara, cerca de la estación de Snowplow 39° 47´ N 21° 13´ E, 27 Jun 2007, *Calvo et al. 925* (MA); Central Pindus range, pr. Mount. Smolikas, Dracolimni 40° 4´ N 20° 54´ E, 28 Jun 2007, *Gonzalo, R. et al.* 738 (MA); Distr. Konitsa: montes Smolikas, in latere meridioali verticis occidentalis montis Vouzi (Bogdani). 40° 8´ N 20° 59´ E, 17 Aug 1976, *Greuter 14548* (C); Ep. Konitsis: Mt. Boukhetsi 6 km NW of Eptakhori. 40° 13´ N 21° 1´ E, 21 Jul 1979, *Hartvig and Christiansen 8236* (C); Pindus Tymphaeus: in summo montis Zygos (Lakmon veter.) supra Metzovo. In peristeri supr. Chaliki 38° 27´ N 21° 27´ E, Jul 1885, *Haussknecht s.n.* (JE); Zyghos, Katara pass 39° 48´ N 21° 12´ E, 14 Aug 2006, *Martins and Müller 1842* (JE). Kastoria: Florinis/Kastorias: 5 km ESE of the village of Kristallopigi place called Papadochoria. 40° 38´ N 21° 5´ E, 19 Jul 1985, *Strid et al . 24719* (M). Kozani: Dhitiki Makedhonia, Vurinos, Nord–und Nordosthänge am Aufstieg vom Ende des SchottersträBchens südwestlich Agios Panteleimon, 39° 26´ N 20° 23´ E, 24 Jun 1985, *Lippert 20827* (M). MACEDONIA. Nom. Pellis: Mt Vorás, 1 km NE of marchy area known as Dobro Pole 41° 3´ N 21° 53´ E, 17 Jul 1981, *Strid, Farsakoglou and Franzén Papanicolau 19161* (C). SeRbia. Tara–Gebirge, ca. 1 km N Kremna 43° 50´ N 19° 34´ E, 21 Jun 1988, *Krendl s.n.* (W).

Notes: Martinovský (1972, 1982) in a narrow concept of the species, initially distinguished *S. novakii* from *S. rechingeri* in base of the lemma, awn size and mainly by the basal leaf ornamentation. Such is the case that both species are placed in different subseries, *Epilosae* and *Atlanticae* respectively. *Stipa rechingeri* is considered endemic of N.W. Greece and characterized by having the basal leaves distinctly scabrous on the

abaxial surface and scabrous with scattered hairs on the adaxial surface, whereas *Stipa novakii* was considered endemic of Serbia, with short anthecium (c. 15 mm long) and the basal leaf–blades scabrous on both surface. On the other hand, Strid (1991) following Freitag (1985) broad concept of species placed both taxa under *S. pennata* subsp. *pulcherrima* (K. Koch) Löve and Löve. He considers that the smaller size of the spikelets and the basal leaf ornamentation are inside the range of variability of *S. pennata* subsp. *pulcherrima*.

The result of this study indicate that both species are the same and clearly distinct than *S. pulcherrima*. The presence of scattered hairs on the adaxial surface is frequently found in other species of the area (*S. endotricha*, *S. pulcherrima* subsp. *crassiculmis*, *S. pennata* subsp. *pennata* L.). Of the two types of *S. rechingeri* studied in this work, one shows hairs (W), while the other one is scabrous (MA). Likewise, populations without hairs are also found in Greece with the lemma measuring 15–18 mm long and the awn 19–25 cm long. Both taxa also have the peculiarity of living in serpentine. Beside the scattered hairs, no other morphological difference has been found; therefore both taxa are included under the same species.

Stipa novakii is characterized by the combinations of: basal leaf–blade scabrous on both surface or with scattered hairs on the adaxial surface, anthecium (14.5)14.9–18(18.3) mm long, awn (17.3)17.5–23(24.8) mm long, and inhabiting serpentine soils. It is the combination of characteristically features as well as its occurrence on Serpentines of Greece, Serbia and Macedonia, which made us to consider the specific rank for this taxon.

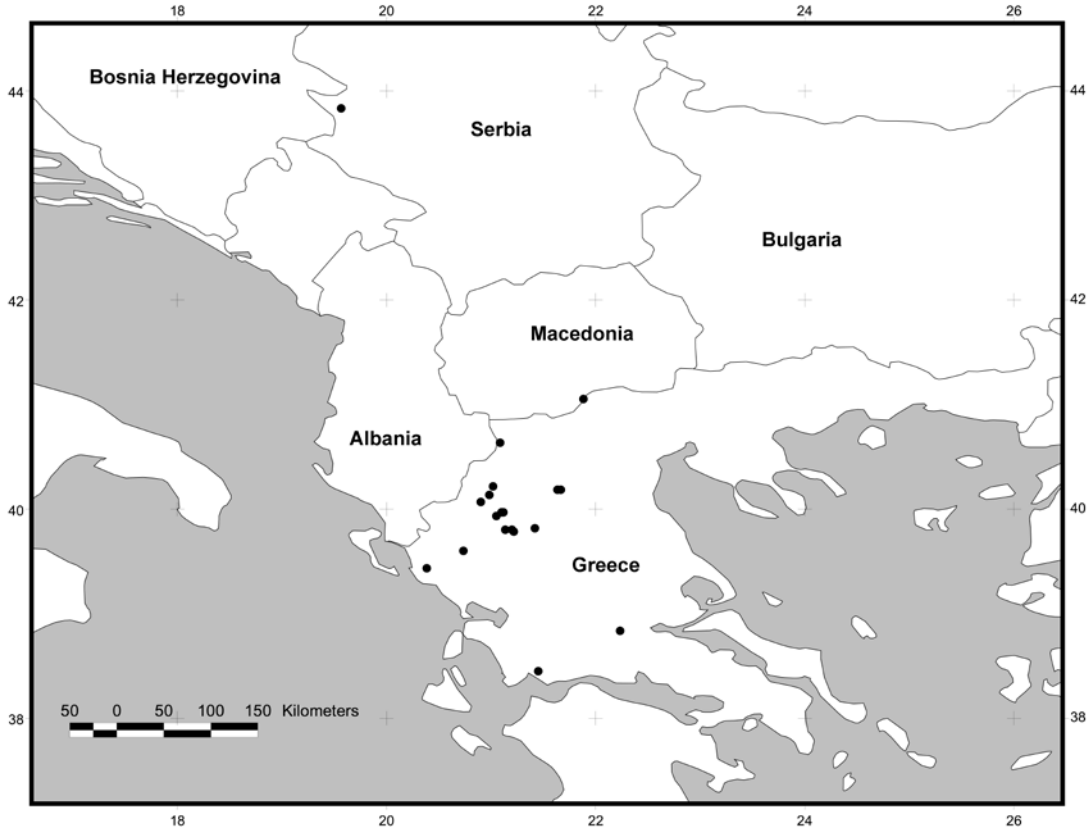

Figure 13. Distribution map: *Stipa novakii* (●).

6. *Stipa pulcherrima K. Koch*

Stipa pulcherrima K. Koch, Linnaea 21: 440. 1848; *Stipa pennata* var. *pulcherrima* (K. Koch) Brand, Wiss. Mitt. Bosnien and Herzegovina 9: 426. 1904; *Stipa pennata* var. *pulcherrima* (K. Koch) Haláscy, Consp. Fl. Graec. 3: 352. 1904; *Stipa pennata* subsp. *pulcherrima* (K. Koch) Freitag, Notes Roy. Bot. Gard. Edinburgh 42(3): 440. 1985, nom. illeg.; *Stipa mediterranaea* subsp. *pulcherrima* (K. Koch) A. Löve and D. Löve, Syn. Mitteleur. Fl. 2: 106. 1890; *Stipa pennata* f. *pulcherrima* (K. Koch) Beck in W.D.J. Koch, Syn. Deut. Schweiz. Fl. ed. 3: 2718. 1907; *Stipa mediterranaea* [A] *pulcherrima* (K. Koch) Asch. and Graebn., Syn. Mitteleur. Fl. 2: 106. 1890; *Stipa pennata* subsp. *pulcherrima* (K. Koch) A. Löve and D. Löve, Folia Geobot. Phytotax. 10: 273 (1975). *Type:* ARMENIA. Tatarisch Grusien, 1848, *Koch s.n.* (lectotype, GOET!. designated by Freitag, 1985).

Herbs 37–84 cm high, perennial caespitose; branching intravaginal. Culms 2–3(4) noded, nodes glabrous, violet or brown; culm internodes pubescent, minutely pubescent, scabrous or glabrous, the remainder glabrous or scabrous. Basal leaves 24–78 cm long, green and occasionally pruinose; leaf–sheath scabrous, glabrous, minutely pubescent or minutely pubescent near the leaf–blade, usually ciliate, cilia (0.12)0.25–0.77(2) mm long; leaf–blade 15–71 cm long, (0.4)0.5–0.96(1.1) mm in diameter, convolute, abaxial surface distinctly scabrous, adaxial surface toatally scabrous or papillae, scabrous, sparsely hairs or ribs scabrous or papillae and furrows minutely pubescent, prickles 0.01–0.04 and hairs (0.05)0.07–0.15(0.17) mm long; ligules (0.7)0.9–2.8(3.8) cm long, rounded, acute, obtuse or truncate, usually scabrous, ciliolate or ciliate, cilia (0.01)0.02–0.52(1.27) mm long. Floriferous culm leaves 27–70 cm long; leaf–sheath 19–45 cm long, scabrous, scabrous near the leaf–blade and margins (rarely with scattered hairs) and with a branch of hairs in the junction blade–sheath and the remainder glabrous or minutely scabrous, margins usually glabrous; leaf–blade 6–25 cm long, (0.34)0.46–0.97(1.2) mm in diameter, abaxial surface scabrous (rarely glabrous), adaxial face scabrous, scabrous with scattered long hairs, totally pubescent or with ribs scabrous and furrows minutely pubescent, hairs (0.05)0.08–0.4(0.65) mm long; ligules (1.8)2.9–11.5(19.5) mm long, acute, lanceolate, obtuse or rounded, scabrous or pubescent, margins and tip glabrous or ciliate, cilia (0.09)0.15–0.73(1) mm long. Panicle 16–59 cm long, contracted, exserted or partially enclosed by the upper leaf–sheath, (3)4–5(6) noded; basal internode 3–49 cm long, pubescent or scabrous; branches (1)2.1–5.1(7.2) cm long, patent or ascending, setaceous or minutely setaceous, setae (0.12)0.17–1.1(1.3) mm long; basal nodes with (1)2 branches with 1(2) spikelets each. Glumes subequal, lanceolate, long acuminate, usually scabrous, sometimes with the central nerve ciliate, cilia (0.02)0.1–1.1(2.1) mm long, green with the margins and tip hyaline (sometimes with purple stains), the lower (5.5)7–9.1(10.3) cm long and 3–5(7) nerved, the upper (5.2)6.5–9(10.1) cm long and (4)5–7(9) nerved. Anthecium (17.8)19.9–24(28) mm long, (0.93)1.07–1.52(2.21) mm wide, fusiform, coriaceous, green, brown or pale brown; lemma (13.8)15.3–18.1(21.8) mm long, near the apex glabrous, with 7 rows of hairs, with the dorsal and subdorsal ones fused and the

remainder rows free (rarely with 6 rows of hairs with the dorsal row absent), the ventral row reaching the top, the dorsal row measuring 1/4–1/2 the length of the lemma (rarely absent), the subdorsal rows equal, shorter or slightly longer than the dorsal row, the lateral row always longer than the dorsal and subdorsal row, lemma with patent hairs (0.43)0.53–0.95(1) mm long; apex glabrous; callus (3.6)4.2–5.9(6.8) mm long, acute, curved, villous with hairs (1.8)2–3(3.4) mm long on the ventral face and (0.9)1.1–1.9(2.3) mm long on the dorsal face, scar elliptic, peripheral ring (0.87)0.95–1.3(1.6) mm long, (0.3)0.32–0.45(0.54) mm wide (ratio wide/length= (0.25)0.30–0.38(0.41)); palea (13.5)14.2–17(18.2) mm long, lanceolate, margins and tip hyaline, dorsally 2–nerved, between the two nerves papillae or glabrous, margins glabrous and tip usually ciliate, rarely with a dorsal row of hair up to 1/2 the length of the palea, green or brown pale; lodicules 3, equal or subequal, with the dorsal ones slightly longer or shorter than the ventral one, acute, lanceolate or linear lanceolate, membranous, glabrous or the dorsal ones ciliate at the apex, dorsal lodicules (1.6)2.2–3.7(4.2) mm long, ventral lodicule (1.65)2.1–3.7(4.1) mm long. Awn (22)29–40(44) cm long, bigeniculate; column (5.4)7–10.3(11) cm long, base (0.55)0.59–0.82(0.89) mm in diameter, twisted, brown or brown and green, glabrous or minutely scabrous; geniculation (1.4)1.7–2.5(2.8) cm long, glabrous, scabrous (rarely with scattered hairs); seta (16.5)21–31(33.2) cm long, (ratio column length/seta length = (0.24)0.27–0.44(0.5)), flexuous, plumose, hairs in lower part (3.6)4–5.7(7) mm long. Anthers (6.5)7.3–11.3(12.5) mm long, usually glabrous, yellow or purple. Ovary glabrous, styles two. Caryopsis (9)10.4–13.1(13.2) mm long, fusiform; embryo 1.3–2.7(2.9) mm long.

6a. Stipa puclcherrima subsp. pulcherrima

Stipa grafiana Stev., Bull. Soc. Imp. Naturalistes Moscou 30: 116 (1857); *Stipa pennata* subsp. *grafiana* (Stev.) Kneuck., Allg. Bot. Z. Syst. 8: 182 (1902); *Stipa pulcherrima* subsp. *grafiana* (Stev.) Jirásek in Dostal, Květena ČSR: 1928 (1950); *Stipa pennata* var. *grafiana* (Stev.) Linden., Fl. Chers. 2: 283 (1868). *Type:* RUSSIA. In campis maeotics versus fontes rivi Kaltschik, *Graff s.n.* (holotype, H!).
Stipa bavarica Martinovský and Scholz, Willdenowia 4: 322–323. 1968; *Stipa pulcherrima* subsp. *bavarica* (Martinovský and Scholz) H.J. Conert in Hegi, Ill. Fl. Mitt.–Eur. ed. 3, 1(6): 425. 1992. *Type:* GERMANY. Finkesntein dictum in Franconia jurassica, 1 Jun 1960, *Scholz s.n.* (holotype, B!)
Stipa pulcherrima subsp. *palatina* H. Scholz and Korneck, Kochia 2: 2. 2007. *Type:* GERMANY. Rheinland–Pfalz: Vorderpfalz, Felshang nördlich Leistadt, 27 May 2003, *Korneck s.n.* (holotype, B, digital image!).
Stipa mayeri Martinovský, Acta Bot. Croat. 30: 141–146. 1971. *Type*: SERBIA, ad Miruša sub montis Koznik, 30 May 1968, *Mayer s.n.* (holotype, LJ).
Stipa glabrinoda Klokov, Novosti Sist. Vyssh. Nizsh. Rast. 1975: 51. 1976; *Stipa pulcherrima* subsp. *glabrinoda* (Klokov) Tzvelev, Bot. Zhurn. (Moscow and Leningrad) 78(10): 94. 1993. *Type:* UKRAINE. Taurica. Sympheropoliemsis distr. Zalessje, declivia, 23 May 1973, *Dubovik s.n.* (holotype, KW).

Stipa glabrinoda f. *subadoxa* Klokov, Novosti Sist. Vyssh. Nizsh. Rast. 1975: 52. 1976, nom. illeg. *Type:* UKRAINE. Crimean region, Tarkhankut Peninsula, Dzhangul, 20 May 1973, *Dubovik and Glagoleva s.n.* (holotype, KW; isotype, LE!).
Stipa oreades Klokov, Novosti Sist. Vyssh. Nizsh. Rast. 1975: 46. 1976. *Type:* UKRAINE. Tauria, Reservtum Naturele Tauricum, mons Czuczel Minor, 12 Jul 1955, M. *Kotov, Ezverov and Romanov s.n.* (holotype, KW; isotype, LE!).
Stipa platyphylla Czern. ex Trautv, Acta Horti Petrop. 9: 350 (1884), nom. nud.; *Stipa pulcherrima* var. *platyphylla* Czern ex Podp., Práce Morav. Přír. Společn. 2: 699 (1926). *Type:* CZECH REPUBLIC. Posud pouze na jedinéno stanovisku v Čechách: stráně nad libšickou stěnou, 18 Jun 1853, no colector (holotype, LE!).
Stipa karadagensis Klokov, Novosti Sist. Vyssh. Nizsh. Rast. 1975: 47. 1976, nom inval, nom prov.; *Stipa pulcherrima* var. *karadagensis* Tzvelev, Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol. 91: 121. 1986. *Type:* UKRAINE. Crimean Region, Karadag, 7 Jun 1974, *Klokov s.n.* (holotype, KW, isotype LE!).
Stipa heterophylla Klokov in Novosti Sist. Vyssh. Nizsh. Rast. 1975: 49. 1976, nom. illeg non Wild. *Type:* UKRAINE.Tauria, Karadag, mons Sujuk–kaja, 11 Jun 1967, *Klokov s.n.* (holotype, KW)
Stipa pulcherrima f. *nudicostata* Martinovský, Preslia 48: 187. 1976. *Type:* CZECH REPUBLIC. Raná prope urbem Louny in Bohemia, Jun 1974, *Martinovský s.n.* (holotype, PRC digital image!).
Stipa pulcherrima var. *paradoxa* Junge ex Roshev. in B. Fedtsch., Fl. Aziat. Ross. 12: 156. 1916; *Stipa paradoxa* (Junge ex Rohev.) P.A. Smirn., Key. Determ Feathergrass: 7. 1927, nom. illeg., non (L.) Raspail; *Stipa syreistschikowii* A. Smirn., Del. Sem. Hort. Bot. Univ. Mosquensis, 36.1948. *Type:* UKRAINE. Crimea. In collibus et montibus aridis ad Koktebel prope Theodoiam tauricam, 16. 26 May 1908, *Junge A. s.n.* (holotype, LE).

Herbs 37–83 cm high. Basal leaf–blade 37–76 cm long, (0.4)0.5–1(1.1) mm in diameter, abaxial surface distinctly scabrous, or at least in the base, adaxial surface with the ribs scabrous or papillae and the furrows minutely pubescent; ligule (0.8)0.9–2.4(3) mm long. Floriferous culm leaf–blades 7–25 cm long, abaxial surface scabrous (rarely glabrous), adaxial surface totally pubescent or with the ribs scabrous and the furrows minutely pubescent. Glumes (5.2)6.8–8.5(10.3) cm long. Anthecium (17.8)19.3–22.9(24.3) mm long, (0.93)1–1.4(2.2) mm in diameter. Lemma (13.8)15.1–17.6(18.3) mm long, with 7 rows of hairs, with the dorsal and subdorsal ones fused and the remainder rows free (rarely with 6 rows of hairs with the dorsal row absent) the ventral row reaching the top, the dorsal row measuring 1/4–1/2 the length of the lemma (rarely absent), the subdorsal rows equal, shorter or slightly longer than the dorsal row, the lateral rows always longer than the dorsal and subdorsal ones. Awn (22)29–42.3(44.2) cm long; column (5.4)7–10.5(11) cm long, (0.55)0.58–0.75(0.78) mm in diameter; seta (16.5)21.6–32.3(33.2) cm long, plumose with hairs (3.6)4.1–5.9(7) mm long. (Fig. 14 a–j; Fig. 2 a_3)

Chromosome Number: 2*n*= 44 Freitag 1985, Tzvelev 1976, Avdulov 1931, Löve and Löve 1974.

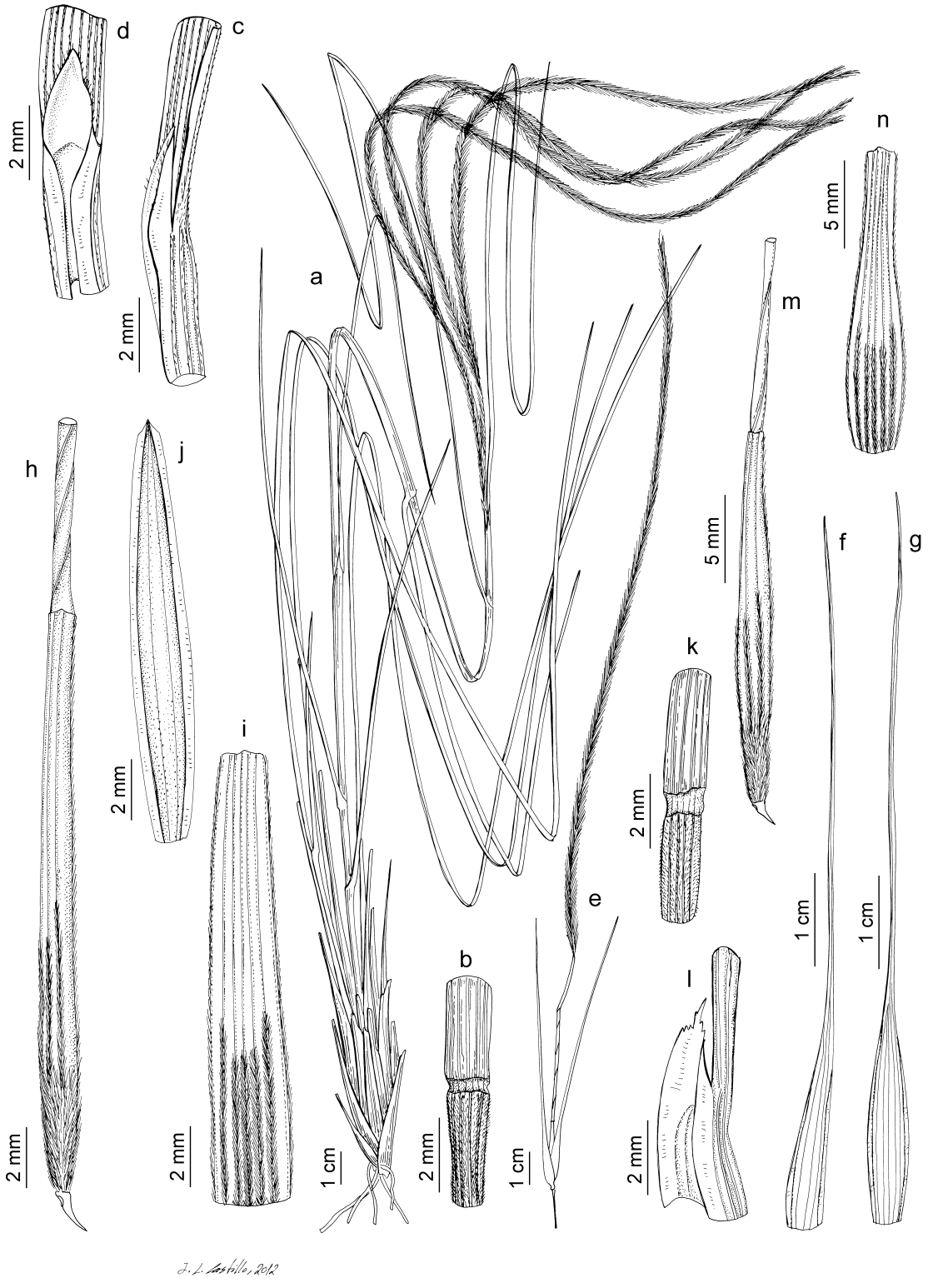

Figure 14. *Stipa pul*cherrima subsp. *pulcherrima*. A, habit; B, floriferous culm node; C, ligule, lateral view; D, ligule, frontal view; E, spikelet; F, upper glume; G, lower glume; H, anthecium and column; I, lemma; J, palea. *Stipa pulcherrima* subsp. *crassiculmis*. K, floriferous culm node; L, ligule, lateral view; M, anthecium and column; N, lemma. [Based on: A–J, *Greuter 16318* (MA); K–N, *Dvořák* 9 May 1972 (H).]

Habitat and Distribution: Inhabits steppes and rocky slopes from sea level up to middle mountain belt at 2500 m high. Specially frequent in central and SE Europe, Caucasus and more sporadically found in South Europe, East Ukraine, Central Iran, west Russia and west Siberia. (Fig. 15).

Phenology: Flowering and fruiting from May to September.

Representative Specimens Examined: ARMENIA. In rupbestribus Bergt dagh, 9 Aug 1865, *Haussknecht s.n.* (W). Ararat: 16 km to East from Ararat town, road to Yerevan to Yeghegnadzor, near border to Vayotsdzor prov. c 4 km NE Tigranashen, 39° 48´ N 44° 58´ E, 23 Jun 2002, *Fayvush et al. Optima Iter XI 1592* (W). Shirak: Akhuryan distr., Shirak range, left slope of the reamrkable gorge NE of Krashen, 1.5 km from the village, 40° 53´ N 43° 58´ E, 26 Jun 2004, *Fayvush et al. 04/1509* (W). AUSTRIA. Carinthia: N Kärnten: Olsa bei Freisach, 46° 57´ N 14° 24´ E, 1971, *Franz s.n.* (W). Käraten: Friesach: Greifeneggen und Südseite des Minachberges, 46° 57´ N 14° 24´ E, Jul 1933, *Zedrosser s.n.* (W, WU); Kärnten: Kursnten: bei Friesach auf dem Vinhrigel, 46° 57´ N 14° 24´ E, 27 May 1961, *Melzer s.n.* (W). Niederosterreich: Eichkogl bei Mödling, 48° 4´ N 16° 11´ E, 26 May 1921, *Smith s.n.* (S); Monte Braunsberg prope Hainburg, 48° 28´ N 16° 20´ E, May 1891, *Ausl s.n.* (PR); In colle Eichkogel ad Mödling prope Wien, 48° 3´ N 16° 17´ E, 15 Jun 1922, *Ausl s.n.* (PR); Monte Bisamberg prope Viennam, 48° 19´ N 16° 21´ E, 28 Jun 1922, *Vestergren s.n.* (S); N, Marchfeld ca. 2 km E Oberweiden, 48° 17´ N 16° 49´ E, 11 Jun 1994, *Sdratt–Ehrendorfer s.n.* (WU); Wolkesdorf im Weinviertel: Wartberg (W–Hang) 0.8 km W Riedental, 48° 23´ N 16° 31´ E, 16 May 1985, *Pokorny and Strudl 7565/3* (W); NW Bisamberg, 48° 19´ N 16° 21´ E, May 1903, *Witasek and Klammerth s.n.* (WU); Weinviertel: bei Matzen auf einem steilen löBhangin Mengen, 48° 24´ N 16° 42´ E, 4 Jun 1968, *Melzer s.n.* (W). AZERBAIYAN. Daghlig Shirvan: Distr. Schemacha, inter pp. Bidzhov et Kelakhany, 40° 30´ N 48° 33´ E, 12 Jun 1937, *Zakarjan s.n.* (NY). BULGARIA. Prope Varna: in deserti ad Exorigrud, 18 Jul 1907, *Schneider 170* (W). Rousse: Area ca. 29 km s of Ruse, valley of river lom, ca. 3 km NE Pepelina, 43° 35´ N 25° 57´ E, 2 Jun 1998, *Uzunov, Gussev and Vitek 98–108* (W). CZECH REPUBLIC. Jihomoravsky: Moravia meridionalis: in declivibus stepposis prope p. Pouzdřany, 48° 56´ N 16° 37´ E, 6 Jun 1926, *Podpera and Jirásek 164* (BR, H, S); Nikolsburg: Steppenahänge des Kesselberges, 48° 48´ N 16° 38´ E, 20 May 1933, *Weber s.n.* (JE). Sud Mohelno: Göding: Sandsteppe bei Rohatetz, 48° 52´ N 17° 11´ E, Jul 1930, *Laus s.n.* (UPS); Mähren vid Pausram, 48° 55´ N 16° 37´ E, 1 Jul 1936, *Anderberg s.n.* (UPS); Znaim, Stierfelsen, 48° 51´ N 16° 3´ E, 9 May 1885, *Morrig s.n.* (WU); Hustopeče, in declivibus stepposis Pouzdřanské kopce, 48° 56´ N 16° 43´ E, 18 May 1926, *Suza 162* (BR, GH, H, JE, K, S, WU). Severocesky: Bohmen: Am Lobosih bei Lobositz, 50° 30´ N 14° 3´ E, 6 Jun 1897, *Lodny s.n.* (W). Zapodocesky: Ranaer Baer, Böhems, 49° 31´ N 12° 45´ E, 21 May 1930, *Sticfelhagers 2412* (L). GEORGIA: Peripheria aouto–orientalis urbis Tblis, in vicinitate pagi Saganlugi, 41° 38´ N 44° 55´ E, 7 Jun 1990, *Vašak s.n.* (BR, NY). Distr. Mckheta, loco "Dzhvari" dicto., 42° 43´ N 42° 3´ E, 22 May 1973, *Vašak s.n.* (M), Tiflis, 41° 41´ N 40° 50´ E, 2 Jun 1882, *Schumann, s.n.* (JE); Tbilisi. Environs of lake Kus–tba ca. 150 m S of the lake, 41° 41´ N 44° 45´ E, 21 May 2005, *Lachashvili 84* (W); Novorossiysk vicinity. Below highway, to the sea, on the 14th km of the Sukhumi highway, 43° 0´ N 41° 1´ E, 10 Jun 1938, *Pyshkovsky 194* (LE); Karbli: Samgerthi, 41° 30´ N 44° 45´ E, 26 May 1932, *Zedelmayer s.n.* (MA); Caucasus: collis Mta–Cminda/gora Davida/ in vicinitae urbis Tbilisi, 42° 14´ N 44° 23´ E, 21 May 1973, *Vašak s.n.* (W); Perpheria urbis Tblisi haud procul a lacu Lisi, 41° 44´ N 44° 44´ E, 17 May 1985, *Vašak s.n.* (W). GERMANY. Bayern: Bad Frankenhausen, Wallenburg, 47° 48´ N 11° 50´ E, 11 Jun 1950, *Meyer s.n.* (JE). Untere Hochebene; um die Kiesgruben westlich von Sammern, 48° 46´ N 12° 58´ E, 11 Jun 1950, *Freiberg s.n.* (MA); Regensberg: Am Keilstein bei Schwabelweis, 49° 2´ N 12° 9´ E, 5 Jun 1938, *Merxmüller s.n.* (M); Neuburg am Lricken Donaunfs Finkenstein, Ralkfelsen, 50° 5´ N 12° 4´ E, 17 Jun 1852, *Sars s.n.* (M); Finkenstein, 50° 5´ N 12° 4´ E, 1 Jun 1982, *Dörr s.n.* (M). Rhineland Pfalz: Ruine Limburg (Kaiserstuhl), 49° 27´ N 8° 9´ E, 21 Jun 86, *Loher s.n.* (NY); Unterfr. Muschelkalkgebiet: bei 250 m im Südsporn des Tietarberges susdloch Thuringersheim, Felsen oberh. des loeges, 49° 38´ N 7° 13´ E, 14 Jun 1986, *Schuhwerk 86/140* (M); Auf Porphyrfelsen im Nahethale oberhalb Kreuznach, 49° 50´ N 7° 52´ E, Jun 1869, *Wirtgen 596* (BR, JE, L). Sachsen–Anhalt: Lissemberg bei Mertendorf (Wetham), 51° 7´ N 11° 51´ E, May 1882, *Lagarski s.n.* (JE); Harz: Quedlinburg, 51° 47´ N 11° 9´ E, 21 Jun 42, *An Hainfolz 399* (JE); Freyburg /U: Schafberg zurischen Zscheiplitz und Weischitz, 51° 12´ N 11° 46´ E, 26 May 1969, *Manitz,*

H. and Manitz, R. s.n. (JE); Sachsen–Anhalt: Steonklöbe b. Nebra, Unstruttal, 51° 17´ N 11° 34´ E, 3 Jun 41, *Erfurt 401* (JE). Thuringia: Badrae Lehde (Dorl)., 51° 24´ N 11° 0´ E, 27 May 2000, *Lewejohann 4532/333* (GOET); Kyffhäusergebiet, Steilhang bei der Barbaros sähohle, 51° 12´ N 11° 17´ E, 23 Jun 1929, *Freiberg s.n.* (M); Sanderhausen: Badraer Lehde, 51° 24´ N 11° 1´ E, 5 Jun 1966, *Manitz s.n.* (JE). GREECE. Vernon Oros: N Klisura, Weg vom Sattelzur Sorgonica, 7 Jul 1978, *Krendl, E.and Krendl, F. s.n.* (W). Central Greece: Flora Attica. In m. Parnethe pr. Dekeleiam (hod. Tatoi), 38° 10´ N 23° 47´ E, May 1828, *Holzmann s.n.* (G). Central Macedonia: Nom. and ep. Thessalonikis, SE of Lit, 40° 44´ N 22° 58´ E, 26 May 1993, *Snogerup10072* (LD); Massif du Kaímaktchalan Macédonie, 40° 58´ N 21° 48´ E, Sep 1938, *Humbort and Topali 355* (G). West Macedonia: Grevená: Palaikastro, Mts Vourinos, 40° 11´ N 21° 38´ E, 1 Aug 2007, *Cabezas et al. 842* (MA); Inter prov. Kozani et Grevena: montes Vourinos, in crista vertices Dherniko (Misio) et Vourinos, 40° 11´ N 21° 39´ E, 26 Jul 1978, *Greuter, W. 16318* (C, MA). HUNGARY. Csongrád: Maros, 46° 15´ N 20° 12´ E, Jun 1891, *Richter Lajvo s.n.* (UPS). Heves: Agria (Erlau) In monte Kis Eged Comit. Heves in Hungaria, 47° 54´ N 20° 22´ E, 30 Apr 1869, *Uralbélyi s.n.* (WU). Pest: Hungarn: Somnige Hänge b. Nagy–maros, 47° 47´ N 18° 58´ E, 5 Jun 37, *Baschant s.n.* (B); Hungarua: Wolfsthal prope Ofen, 47° 30´ N 19° 2´ E, 5 May 1882, *Steimitz s.n.* (NY, S); Comit. Hont. In rupestribus andesticis montis Ördöghegy supra pag. Nagymaros, 47° 46´ N 18° 56´ E, 8 May 1949, *Kárpáti s.n.* (S). Tolna: Baranya: Pécs Area, Mecsek Mts, Dömörkapu, 46° 11´ N 18° 38´ E, 31 May 1987, *Steiner et al. 1202* (UPS); Frlfnn vin vnr Garrn müfln bei Mulb, 46° 11´ N 18° 38´ E, *Vincény Szanfer s.n.* (H). Veszprém: 100 m boven Balatonfüred "Trockenrasen" op. Z.O.–helling, 47° 7´ N 17° 55´ E, 19 May 1972, *Kramer 4962* (G, U). ITALY. Appulia: Puglie: promotorio del Monte Gargano, 41° 50´ N 16° 0´ E, 1956, *Febaroli s.n.* (MA); Mt. Gargano, Südabfall, nördl. Manfredonia entlang der Strabe nach Ruggiano, 41° 48´ N 15° 54´ E, 1964, *Hertel 3656* (M). Friul–Venecia Julia: Felsen inter Contovello bei Triest, 45° 42´ N 13° 44´ E, 17 May 1882, *Kaunwern s.n.* (UPS). Lombardia: Valvestino. Unterhalb Turano an der Strabe nach Gargano, 45° 46´ N 10° 36´ O, 16 Jun 1957, *Schulze–Menz and Knoll 114* (MA). IRAN. Yazd: In monte Ghogeh Dagh W Bazorgan ad confines Turciae, 31° 4´ N 54° 22´ E, 1 Aug 1971, *Rechinger, W. 44007* (G, W). MACEDONIA. Northeastern: Supra Morani, ad basin montis Kitka, 42° 6´ N 22° 28´ E, 26 May 1917, *Bornmüller 2186* (JE). Pelagonia: Pletwar bei Prilep, 41° 21´ N 21° 35´ E, 17 Jun 1967, *Vent s.n.* (B); Pelogonia: ca. 6–7 km N Prilep, am zweiten Vorberg des Zlatovrh, 41° 24´ N 21° 33´ E, 26 Jun 1977, *Krendl, E. and Krendl, F. s.n.* (W); Skopje: Nsküb in monte Vodno, ad Neresi, 41° 58´ N 21° 23´ E, 24 May 1917, *Bornmüller 2184* (NY). Skopje: Uskub, in viridis monte Vodno, 42° 0´ N 21° 26´ E, 10 May 1917, *Bornmüller 2187* (JE). Southeastern Macedonia: Morani, ad basin montis Bistri, 41° 13´ N 22° 26´ E, 20 May 1917, *Bornmüller 2183* (NY). Southwestern Macedonia: NW von Debar, on von Grn Kosovrasti, 41° 31´ N 20° 31´ E, 4 Jul 1976, *Krendl, E. and Krendl, F. s.n.* (W). POLAND. Zachodniopomorskie: Bielinek. Szczecin Prov. Sunny slope of River Odra valley, 53° 32´ N 14° 33´ E, 21 May 1961, *Ceynowa–Gieldon s.n.* (JE); Bielinek, 52° 56´ N 14° 8´ E, 25 May 1961, *Ceynowa s.n.* (JE). ROMANIA. Cluj: Transylvania: Langenthal, in collibus asperis, 46° 7´ N 24° 3´ E, 10 Jun 1887, *Barth s.n.* (PR); In collibus Langenthal, 46° 7´ N 24° 3´ E, 10 May 1885, *Barth s.n.* (H, U); Comit. Kis–Küküllö. In collibus aridis prope pagum Hosszu–Aszó, 46° 7´ N 24° 3´ E, 25 May 1900, *Barth s.n.* (JE, W, WU); Siebenburgen: Schutzgebiet, Finatele Clujului bei Klausenburg, 46° 46´ N 23° 36´ E, 26 May 1969, *Metlesics s.n.* (W). Turda: II Transsilvania. Torda in montibus apricis, solo clacareo–argilloso, 46° 34´ N 23° 47´ E, *Wolff 3987* (GH, JE, W, WU). Sibiu: Distr. Braşov. In decilivibus aridis prope pag. Barcut, 46° 0´ N 24° 55´ E, 19 Jun 1978, *Parascan and Danciu s.n.* (JE, LU). RUSSIA. Alania: Caucasus Magnus: Osetia Borealis, distr. Vladikavkaz, iugum montimum Skalystyj khrebet, in vallis rivi Fiagdon apud pagi Fiagdon, 43° 11´ N 44° 21´ E, 29 Jun 1990, *Čuba s.n.* (NY). Bashkortostan: Privolzhsky (volga). Bashkiria Kvarkeiskii r–n, upper course Kaieshtsh, 53° 28´ N 57° 26´ E, 30 Jul 1913, *Afanasaev s.n.* (H, JE, S, WAG, W). Dagestan: Terskaya Province. Khasav–yurt, 43° 15´ N 46° 35´ E, 10 May 1890, *Lipsky 275* (W). Kabardina Balkaria: Balkaria, the southern slope of Mekhtygen. Guzoy–kyunnyum, 43° 7´ N 43° 31´ E, 31 Aug 1927, *Busch, E. and Busch, N. s.n.* (WU). Kalmykia: Ca. 15 km SW of Elista, 46° 12´ N 44° 5´ E, 15 Jun 1994, *Skvortsov s.n.* (GH). Krasnodar: Southern open slopes of the mountain, 44° 44´ N 38° 9´ E, 21 May 1907, *Busch, F. and Klopotow s.n.* (LE); On the south–western slope of mountain range Markoth near Novorossiysk, 44° 43´ N 37° 46´ E, 19 Jun 1926, *Dzevanovsky 16* (LE); Kuban District. Village Kavkazskaya (Kropotkin). Left bank of Kuban' River against the village Kazanskaya, 45° 26´ N 40° 34´ E, 6 Jul 1926, *Schiffers 814* (S); Kuban province, Baraniy Rog, peated

places, 44° 31´ N 38° 40´ E, 7 May 1907, *Busch, F. and Klopotow s.n.* (S); In decliviis ad fl. Aderba prope opp. Gelendzhik, 44° 34´ N 38° 4´ E, 25 May 1907, *Litvinov 5655a* (H, JE, NY, S). Orenburg: Zilair District. 2.5–3 km to the south of station Kuvandyk, 51° 28´ N 57° 21´ E, 7 Aug 1928, *Krascheninnikov 60* (U). Rostov: Land of Don Cossaks. Valley of Sal river. The divide between the rivers Don and Sal 7 km N of Atamanksoj, 47° 30´ N 40° 54´ E, 25 Jul 1928, *Gorschkowa 359* (JE, S); Don Region, railway station Persianovka (South–Eastern Railway), 47° 31´ N 39° 25´ E, 12 May 1920, *Ivanova and Nashvpino s.n.* (NY); Persianovskiy reserve, 47° 31´ N 39° 25´ E, 13 Jun 1963, *Panazyan 20* (G). Stávropol: Caucasus, prov. Stavropol, mons Sedlo prope urb. Kislovodsk, 43° 54´ N 42° 43´ E, Jun 1906, *Litvinov 5655* (GH, H, JE, NY, S). Tuva: Uryankhai. Vicinity of Bai–khav, 51° 5´ N 92° 47´ E, 27 Jun 1915, *Nivmasheva s.n.* (LE). Volgograd: Ad pagum Sirotinskaia (districtus Ilovlinski), in declivibus cretceis ad flumen Don, 49° 15´ N 43° 40´ E, 9 Jun 1990, *Sagalaiev 17774* (BR, H, MA); Distr. Olkhovka, ca. 10 km W ab Olkhovka declive cretaceum, 49° 51´ N 44° 24´ E, 29 May 1983, *Skvortsov s.n.* (GH), Ad. Tanain med. Fontes ilum. Golubajanon procul a pag. Sirotinskaya, 49° 15´ N 43° 40´ E, 5 Jun 1938, *Smirnow 35* (H, JE, S); Right shore of River Don, Kletskiy District, near village Sirotinskaya, 49° 15´ N 43° 20´ E, 7 Jun 1930, *Ikonnikov et al. 5905* (LE). SERBIA. South Backa: Slavonia. Fruska–Gora, 45° 9´ N 19° 42´ E, 12 Jul 1907, *Prodán s.n.* (PR). SLOVAKIA. Košice: Slovenský Kras, silvis apertis Zadielský Kámen dictis in declivibus meridionalibus supra kotam 271 prope Zádiel, 48° 36´ N 20° 50´ E, Jun 1933, *Klášterský and Miloš Deyl s.n.* (H). Bratislava: Kleine Karpaten montis Thebner kogl, 48° 11´ N 17° 0´ E, 20 May 1928, *Rechinger, K.H. s.n.* (S). SLOVENIA. Banská Bystrica: Slovakia australis, distr. Rožňava, planities Silická planina, prope pagum Kečov, clivi collis Husí vrch, 48° 18´ N 18° 58´ E, 25 May 1979, *Vašak s.n.* (BR). TURKEY. Istanbul: Vallé dç Aidinly prés de Pendik, 40° 52´ N 29° 16´ E, 16 Jun 1895, *Aznavour 2365 B* (G). TURKMENISTAN. Ahal: Aschabad: Suluklü (Saratowka); ad fines Persiae, 37° 57´ N 58° 23´ E, 2 Aug 1900, *Hackel 1050* (W). UKRAINE. Krym: Southern coastal range "Yaila", near village of Novopaulovka, 22 km from Simferopol, 44° 57´ N 34° 6´ E, 30 May 1981, *Newcombe 5746* (NY), Sudak. In glareosis montes Sokoll, 44° 51´ N 34° 48´ E, D*örfler 764* (M, W, WU); Vicinity of Feodosia, 45° 1´ N 35° 22´ E, *Sarandinakai s.n.* (S).

6b. Stipa pulcherrima subsp. crassiculmis (P.A. Smirn.) Tzvelev.

Stipa pulcherrima subsp. *crassiculmis* (P.A. Smirn.) Tzvelev, Novosti Sist. Vyssh. Rast. 11: 18. 1974; *Stipa crassiculmis* P.A. Smirn., Feddes Repert. Spec. Nov. Regni Veg. 22: 375. 1926. *Type:* TURKMENISTAN. Turcomania. Montes Kopet–Dag, in transvall. Arvas, *Kultiassow s.n.* (holotype, TAK)

Stipa crassiculmis subsp. *euroanatolica* Martinovský, Bot. Jahrb. Syst. 87: 395. 1967. *Typus:* BULGARIA. Stanimaka, 1892, *Velenovský and Stříbrný s.n.* (holotype, PRC digital image!).

Stipa crassiculmis subsp. *heterotricha* Dihoru and Roman in Rev. Roumaine Biol., Sér. Bot. 22: 24. 1977. *Type:* ROMANIA. In angustis fluminis Olt (Aluta) montis Coziae intra valles Turneanu et Armasaru, 1975, *Roman s.n.* (holotype, BUCA).

Stipa crassiculmis subsp. *picentina* Martinovský, Moraldo and G. Caputo, Delpinoa 16–17: 186. 1976. *Type:* ITALY. Pascolo sassoso, al di sopra del Vallonedella Caccia in territorio di Senerchia. 17 Jul 1975, *Caputo and Moraldo s.n.* (holotype, NAP; isotype, FI, digital image!).

Stipa transcarpatica Klokov, Novosti Sist. Vyssh. Nizsh. Rast. 1975: 54. 1976. *Type:* UKRAINE. Transcarpathian Region, Vinogradov, Chernaya Gora, 20 Jun 1969, *Zaverucha s.n.* (holotype, KW; isotype, LE!).

Stipa paradoxa subsp. *glabricostata* Martinovský, Bot. Jahrb. Syst. 87: 389 (1967). *Type:* IRAN, Sultan Dagh, *Bornmuller 5635* (holotype, B!).

Herbs 38–84 cm high. Basal leaf–blade 15–56 cm long, 0.5–0.9(1) mm in diameter, abaxial surface distinctly scabrous, adaxial surface totally papillae, scabrous or scabrous with sparsely long hairs; ligule 0.7–3.7(3.8) mm long. Floriferous culm leaf–blades 6–22 cm long, abaxial surface scabrous (rarely glabrous), adaxial surface scabrous or scabrous with sparsely long hairs. Glumes (5.3)6.7–10(10.3) cm long. Anthecium (19.9)20–25(28) mm long, (1)1.1–1.5(1.8) mm in diameter. Lemma (15.1)15.43–19.4(21.8) mm long, with 7 rows of hairs, with the dorsal and subdorsal ones fused and the remainder rows free (rarely with 6 rows of hairs with the dorsal row absent) the ventral row reaching the top, the dorsal row measuring 1/4–1/2 the length of the lemma (rarely absent), the subdorsal rows equal, shorter or slightly longer than the dorsal row, the lateral rows always longer than the dorsal and subdorsal. Awn (27)28.2–38.5(44) cm long; column (5.9)7–9.5(10.7) cm long, (0.58)0.6–0.84(0.89) mm in diameter; seta (18.5)20–30(33) cm long, plumose with hairs (3.7)4.2–6.3(7.2) mm long. (Fig. 14 k–n; Fig. 2 a_1–$a_{2)}$.

Chromosome Number: 2*n*= 44 Moraldo 1986 sub *S. crassiculmis* subsp. *picentina*.

Habitat and Distribution: Inhabits open forest, rocky slopes, steppes, meadows, from sea level up to middle mountain belt at 2600 m high. From South West and Central Europe, through Turkey, Caucasus and sporadically in North Iran. In central Asia, occurs in the Kopet Dagh Mountains, and one specimen studied from Western Russia and one from Alai Mountains of Kazakhstan. (Fig. 15).

Phenology: Flowering and fruiting from May to August.

Represetative Specimens Examined: ALBANIA. Subalpine Wiesen am Südwesttabhang des Pashtrik, 41° 47´ N 20° 31´ E, 8 Jul 1918, *Zerny s.n.* (W). AUSTRIA. Oberösterreich: Vintechgran: Burgeis, Trockenstellen ob dem Dorf, 48° 25´ N 13° 55´ E, 1 Aug 1953, *Becher s.n.* (G). ARMENIA Ararat: distr. Ararat, montes "Gegamski khrebet" in vicinitate ruinarum pagi Akhkeng, 40° 15´ N 44° 59´ E, 10 Jul 1975, *Vašak s.n.* (B, G, M, MA, W, WAG); Ararat: Lusashoh, way to small lake, 39° 51´ N 44° 57´ E, 10 Jun 2004, *Fayvush et al. 04/331* (W). Kotayk: Caucasus, distr. Razdan, clivi montis Ketandag in vicinitate pagi Charencavan, 40° 24´ N 44° 38´ E, 7 Jul 1975, *Vašak s.n.* (BR, NY, W); distr. Ashtarak, in declivinus montis Arailer, in vicinitate pagi Egvart, 40° 24´ N 44° 28´ E, 15 Jul 1975, *Vašak s.n.* (B, G, K, M, MA, W, WAG); Abovian distr. c. 8 km NW Charentsavan, c. 2 km NW Arzakan, Aghveran gorge, 40° 29´ N 44° 36´ E, 28 Jun 2002, *Fayvush et al. Optima Iter XI 2310* (W). Lorri: The vicinity of the town Kirovakan, mountains Sarushsahlu, 40° 48´ N 44° 29´ E, 5 Jun 1975, *Gabrielyan and Yankun s.n.* (W). AZERBAIYAN. Kalbajar–Lachin: Kurdistan inter p. Min=Kena et monte Ischichly, 39° 34´ N 46° 10´ E, 26 Jul 1931, *Heydemanand Isaev s.n.* (M). Nakhchivan: Nachrespublica: Ordubad in m–bus supra p. Hanra, 38° 54´ N 46° 1´ E, 31 Jun 1933, *Heidusan s.n.* (GH); Nachrespublica: prope pag. Bitshenach, 39° 8´ N 45° 52´ E, 3 Aug 1931, *Prilipko and Vichert* (GH). BULGARIA. Prope Silven: in monte Bnrnunb, 16 Jul 1907, *Schneider 409* (W). Burgas: Southern costal area of Black Sea, 5 km NE of Nessebar, E of Vlas, near Elenite Kozlushko dere place, 42° 42´ N 27° 48´ E, 31 May 1999, *Raus and Pina Gata 30–1–18* (W). Plovdiv: Stanimaka, 42° 1´ N 24° 52´ E, 1892, *Velenovský and Stříbrný s.n.* (PRC). CZECH REPUBLIC. Gruppe 19, 7 Jul 1980, no collector (WU). GERMANY. Baden–Württemberg: Sonnige Grashalde ob Schelingen Kaiserstuhl, westlich von Freiburg im Breisgau, 48° 6´ N 7° 40´ E, 23 May 1954, *Keller s.n.* (G). GREECE. Central Greece: Fthiotidos, Ep. Lokridos, Mt Kallidromo. c. 3 km N of Modion along road to Reginion, 38° 41´ N 22° 41´ E, 18 Jun 1988, *Thornberg s.n.* (C). Thessaly: Trikala: Mt. Neraïda, 3 Km N of Chatsipetrion, 39° 26´ N 21° 14´ E, 25 Jun 1971, *Aldén 1121* (LD). IRAN.

Āžarbāyjān–e Sharqī: Sultan Dagh, 37° 46´ N 46° 18´ E, *Bornmuller 5635* (B). Khorasan: 2–3 km East of Sharleq towards Almeh, 37° 20´ N 56° 4´ E, 22 May 1995, *Akhani 10777* (M); Eastern border of Shakha Mountain, LAteh Tas, 37° 19´ N 55° 51´ E, 5 Jul 1995, *Akhani 11630* (M); 2=4 km SW of Soolegerd, 37° 26´ N 56° 7´ E, 7 Jul 1994, *Akhani 9507* (M); Khorasan: E Mazandaran, NW Khorasan. Southern side of Qortoy valley near Cheshmehe Podan–Ali (Poda–Ali spring), 37° 26´ N 55° 55´ E, 17 Jun 1995, *Akhani 11282* (W). Mazandaran: Prov. Gorgan. Monte Shahvar prope Hadjilang, 36° 34´ N 54° 45´ E, 26–27 Jul 1948, *Rechinger, K.h and Rechinger, F. 6072* (G, W). ITALY. Campania: Pascolo sassoso, al di sopra del Vallonedella Caccia in territorio di Senerchia, 40° 44´ N 14° 46´ E, 17 Jul 1975, *Caputo and Moraldo s.n.* (FI); Lombardia: Provaglio, 44° 50´ N 10° 31´ E, 16 Jun 1984, *Moraldo and Meuti s.n.* (Herb Moraldo, digital image); Brescia: Rezzato, 45° 31´ N 10° 19´ E, 16 Jun 1984, *Moraldo s.n.* (Herb Moraldo, digital image). Sicilia: In sterilibus montosis Palermoa monte Falcone, 38° 6´ N 13° 40´ E, *Todaro 986* (W). KAZAKHSTAN. East Kazakhstan: Altai, fl. Istysch prope Mecht, 48° 34´ N 83° 19´ E, 12 Jun 1931, *Schischkin and Sumnevicz s.n.* (NY). MACEDONIA Pelagonia: Peristeri in Macedonia, 40° 55´ N 21° 10´ E, Aug 1893, *Formánek s.n.* (PR, W). POLAND. Szczecin: North Polonia. Bielinek/Szczecin Prov/ On a sunny slope of River Odra valley, 52° 55´ N 14° 8´ E, 21 Jun 1969, *Ceynowa–Gieldon 295* (H). RUSSIA. Uscelbe u sm. Sakogava, 23 Jun 1918, *Koslovskiy 1348* (H, MA, U). Krasnodar: Caucasus: distr. Krasnoselskoie, montes Areguni in vicinitate pagi Tokludza, 45° 15´ N 40° 34´ E, 31 Jul 1975, *Vašak s.n.* (M, W). Novosibirskaya Oblast': Turcia, inter opp. Sarykamysh et pag. Promezhutocznoje, 5 Jul 1914, *Litvinov s.n.* (G, M, W). Samara: Vinogradov, 52° 46´ N 49° 50´ E, *Zaverucha s.n.* (LE). Severnaya Osetiya–Alaniya: Caucasus: Ossetia, ad pagum Tib pr fl. Ardon, 43° 14´ N 44° 18´ E, Jul 1877, *Brotherus s.n.* (W). SERBIA. In saxosis Strbac (Serbia Oriental), 43° 30´ N 22° 19´ E, May 1872, *Pancic s.n.* (W). SLOVENIA. Collis Kovačovske, in declivibus saxosis prope pagum Kovačov, 9 May 1972, *Dvořák s.n.* (H). TURKEY. ankırı: Gerede–Ilgaz 8 km e Ismetpasa, 40° 40´ N 33° 25´ E, 7 Jul 1977, *Nydegger 12070* (G). Artvin: ca. 26 km E Demirkent A8 Artvin, 40° 52´ N 41° 29´ E, 14 Aug 1981, *Sorger s.n.* (W). Burdur: Gölhisar–Korkuteli 13 km s Gölhisar, 37° 9´ N 29° 30´ E, 11 Jul 1978, *Nydegger 13135* (G). Erzincan: Ilic – Kemah 4 km e Hasanova, 39° 32´ N 38° 35´ E, 24 Jun 1992, *Nydegger 46426* (G); Erzurum: Vilayet: zwischen Askale und Bayburt auf dem Kodağı gecidi, 39° 55´ N 40° 41´ E, 2 Aug 1973, *Holtz, Hänel and Kesercioğlu 00.981* (H, LD); Kars: Sarikamis–Karaurgan 11 km w Sarkamis, 40° 14´ N 42° 16´ E, 23 Jul 1989, *Nydegger 44560* (G). Kayseri: Erdschias dagh. Aenien auf Abhängen oberhalbe Yerane, 38° 32´ N 35° 27´ E, 13 Jun 1902, *Zederbauer s.n.* (W). Mus: Bus. Bulanik–mus, Weiden 3 km nach Hasangöran, 38° 57´ N 41° 54´ E, 14 Jul 1951, *Huber–Morath 11629* (G). Van: B9 van. 3 Km SW Caldiran, 39° 8´ N 43° 54´ E, 12 Jul 1981, *Melzer s.n.* (W). TURKMENISTAN. Ahal: Ashkhabad District. Slope of mountain Chapan–dagh, 37° 48´ N 58° 2´ E, 25 Aug 1931, *Borisova 779 a* (LE); Balkan: Krasnovodskiy region. Rise from the gorge (ravine) Ap–dere to the high plateau of Nukhu, 38° 29´ N 57° 38´ E, 30 Jun 1916, *Dubiansky s.n.* (LE).

Notes: *Stipa pulcherrima* subsp. *pulcherrima* is sometimes mistaken with *S. eriocaulis*. Both taxa are probably the most common and widespread taxa of subsect. *Pulcherrimae* in Europe and the differentiation of both taxa becomes specially blurred in their contact areas. The size of the spikelets, and the ornamentation of the lemma and of the basal leaves have been traditionally used to distinguished both taxa (Martinovský 1982; Connert 1982); the lemma of *S. eriocaulis* usually exhibit 6 rows of hairs with the dorsal row absent, whereas *S. pulcherrima* subsp. *pulcherrima* could exhibit distinctly 6 or 7 rows. However, sporadically we have found specimens of *S. eriocaulis* which also exhibit a short dorsal row, being this feature of doubtful use. The spikelets of S. *pulcherrima* subsp. *pulcherrima* are usually quite longer than *S. eriocaulis*, although specimens traditionally called *S. eriocaulis* subsp. *dvorakyi* (Martinovský 1982; Moraldo 1986), are more robust and falls inside within the variation of *S. pulcherr*ima. Almost certainly, the basal–leaf ornamentation exhibit the most practical characters, despite that both species are mainly characterized by having the adaxial surface with the ribs scabrous or papillae and the furrows minutely pubescent. However, *S. pulcherrima*

subsp. *pulcherrima* present the abaxial surface distinctly scabrous and the leaf–sheath usually glabrous or only hairy near the leaf–blade, whereas *S. eriocaulis* has the abaxial surface usually glabrous of minutely scabrous at the base and the remainder glabrous and the basal leaf–sheath hairy. Therefore, no unique feature characterized these species, and the combination of character is needed to distinguish them.

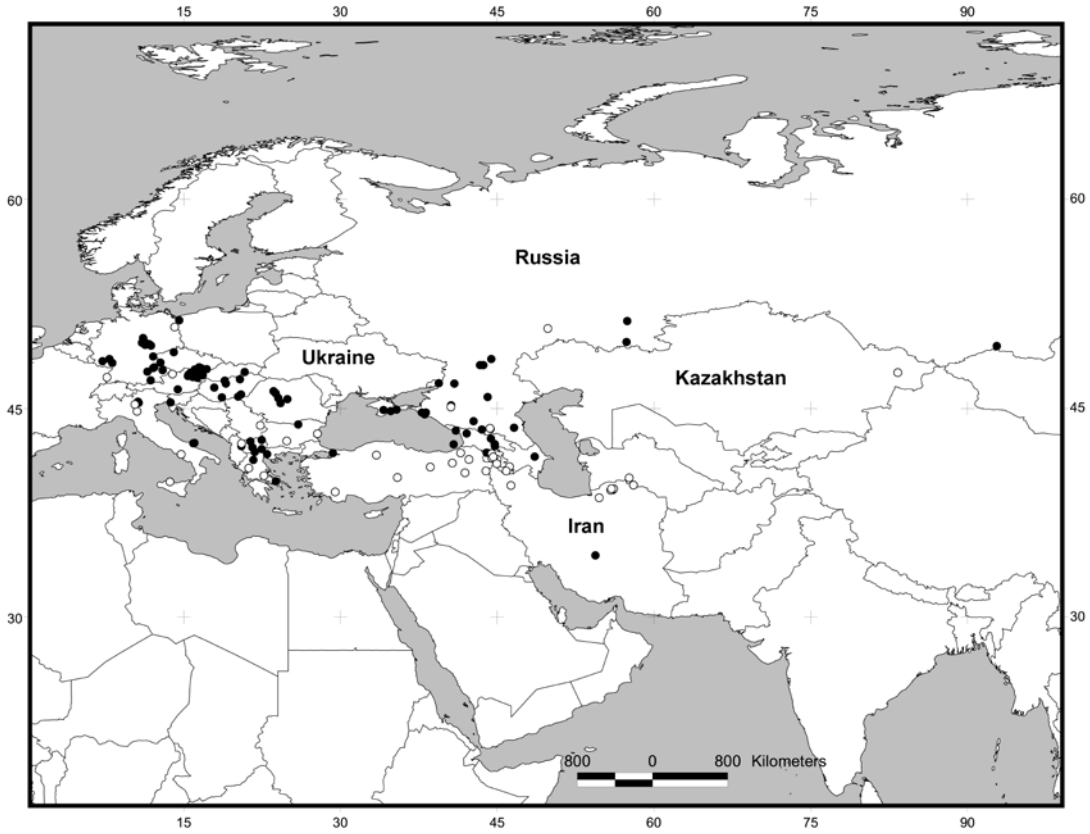

Figure 15. Distribution map: *Stipa pulcherrima* subsp. *pulcherrima* (●); *S. pulcherrima* subsp. *crassiculmis* (○).

The high variability of *S. pulcherrima* has led to the description of many new species and subspecies. A careful study of many specimens has convinced us that *S. pulcherrima* presents a continuum of variation and we find no support for many subspecies, as well as many species, which reflect only a highly variable taxon. In our revision we have finally retained one subspecies, which exhibit constant characters. Subspecies *crassiculmis* at difference of subsp. *pulcherrima* exhibit the adaxial surface of the culms and basal leaves totally scabrous or scabrous with sporadically scattered long hairs. Instead, subsp. *pulcherrima* has the central nerve at least minutely pubescent, and the remainder nerves with the furrows minutely pubescent and the ribs scabrous.

7. Stipa eriocaulis Borbás

Stipa eriocaulis Borbás, Oesterr. Bot. Z. 33: 401. 1883; *Stipa pennata* subsp. *eriocaulis* (Borbás) Martinovský and Skalicky, Preslia 41: 331. 1969. *Type*: Ind loc. HUNGARY. Fiume, Buccari–Station (Sala draga) und Kostrena wachst (holotype probably in BP or PRC)

Herbs 23–80 cm high, perennial caespitose; branching intravaginal branching. Culms 2–3 noded, nodes glabrous, violet or brown; culm internodes usually pubescent, the remainder pubescent or scabrous. Basal leaves 24–82 cm long, green; leaf–sheath minutely pubescent, usually ciliate, cilia (0.11)0.17–0.7(1.4) mm long; leaf–blade 13–74 cm long, (0.4)0.5–0.8(1) mm in diameter, convolute, abaxial surface glabrous or minutely scabrous at the base and the remainder glabrous, adaxial surface ribs scabrous or papillae and furrows minutely pubescent, prickles 0.01–0.4 and hairs 0.03–0.21 mm long; ligules (0.5)1–3.4(6.7) cm long, rounded, acute, obtuse or truncate, pubescent or scabrous, usually ciliate, cilia (0.03)0.09–0.90(1.36) mm long. Floriferous culm leaves 15–47 cm long; leaf–sheath 8–34 cm long, totally scabrous, scabrous near the the leaf–blade and the margin and the remainder glabrous or pubescente near the margins and the leaf–blade and the remainder scabrous or glabrous, margins usually glabrous; leaf–blade 4–15 cm long, (0.3)0.36–0.6(1.3) mm in diameter, abaxial surface glabrous, scabrous or with sparsely stiff hairs, adaxial face totally pubescent or with the ribs scabrous and the furrows minutely pubescent, prickles 0.01–0.04 hairs 0.05–0.32 mm long; ligules (1.8)2.4–6.2(8.5) mm long, acute, rounded, obtuse or irregular, usually pubescent, margin and tip usually ciliate, cilia (0.05)0.3–0.66(0.84) mm long. Panicle 14–63 cm long, contracted, exserted or partially enclosed by the upper leaf–sheath, (2)3–5(6) noded; basal internode 7–51 cm long, usually pubescent; branches (1.3)1.9–3.7(4.7) cm long, patent or ascending, usually setaceous or minutely setaceous, setae (0.01)0.1–0.7(1.9) mm long; basal nodes with (1)2 branches with 1(2) spikelets each. Glumes subequal, lanceolate, long acuminate, usually glabrous (rarely smooth when becomes acuminate), sometimes with the central nerve ciliate, cilia (0.02)0.15–1.3(1.62) mm long, green with the margins and tip hyaline (sometimes with purple stains), the lower (4.2)5.2–7.4(8) cm long and 3–5(7) nerved, the upper (4)4.7–6.7(7.5) cm long and 5–7(9) nerved. Anthecium (14.1)15.5–19.8(21.2) mm long, (0.8)1–1.3(1.5) mm wide, fusiform, coriaceous, green, brown or pale brown; lemma (10.9)11.9–15.5(16.4) mm long, near the apex glabrous, usually with 6 rows of hairs with the dorsal row absent with the subdorsal rows fused and the remainder rows free or with 7 rows of hairs with the dorsal and subdorsal ones fused and the remainder rows free (rarely with 8 or 9 rows of hairs), the ventral row of hairs reaching the top or ending (1.9)2.3–5 mm below the top, the dorsal row absent or measuring 1/3–1/2 the length of the lemma, the subdorsal longer than the dorsal row, the lateral rows always longer than dorsal and subdorsal, lemma with patent hairs (0.4)0.5–0.8(1) mm long; apex glabrous; callus (2.6)3.3–4.7(5) mm long, acute, curved, villous with hairs (1.5)2–2.8(3.3) mm long on the ventral face and (0.9)1.2–1.9(2) mm long on the dorsal face, scar elliptic to rounded, peripheral ring (0.7)0.9–1.2(1.3) mm long, 0.3–0.4(0.44) mm wide (ratio wide/length= (0.25)0.29–0.37(0.42)); palea (10.8)11.4–14.9(16.3) mm long, lanceolate, margins and tip hyaline, dorsally 2–nerved, between the two nerves papillae or glabrous, margins glabrous and tip usually ciliate, rarely with a dorsal row of hairs 1/2–2/3 the length of the palea, green or brown pale; lodicules 3, equal or subequal, with the dorsal ones slightly longer or shorter than the ventral one, acute, lanceolate or linear lanceolate, membranous, glabrous or the dorsal lodicules ciliate at the apex, dorsal lodicules (1.8)2.4–3.4(3.9) mm

long, ventral lodicule (1.7)2.2–3.5(4.2) mm long. Awn (16.1)21.5–28.9(33) cm long, bigeniculate; column (3.2)4.9–7.3(8.9) cm long, base (0.42)–0.5–0.7(0.82) mm in diameter, twisted, brown or brown and green, usually glabrous (rarely hairy); geniculation (1.2)1.5–2.2(2.5) cm long, glabrous, scabrous or sparsely pilose; seta (11.3)15.8–21.9(26.5) cm long, (ratio column length/seta length = (0.16)0.25–0.43(0.5)), flexuous, plumose, hairs in lower part (3.5)4.1–5.8(6.7) mm long. Anthers (6)7–9.7(11.2) mm long, usually glabrous yellow or purple. Ovary glabrous, styles two. Caryopsis (7.7)8.2–1.7(13.2) mm long, fusiform; embryo (1.3)1.5–2.2(2.5) mm long.

7a. Stipa eriocaulis subsp. eriocaulis

Stipa pennata subsp. *austriaca* (Beck) Martinovský and Skalický, Preslia 41: 331. 1969; *Stipa pennata* [beta] *austriaca* Beck, Fl. Nieder–Österreich 2: 49–50 (1890); *Stipa joannis* [unrancked] *austriaca* (Beck) Jáv., Magyar Fl. 1: 69 (1924), comb. inval.; *Stipa pennata* f. *austriaca* (Beck) Hayek, Prodr. Fl. Penins. Balcan. 3: 349. 1932; *Stipa eriocaulis* subsp. *austriaca* (Beck) Martinovský, Bot. Közlem. 54: 51. 1967; *Stipa austriaca* (Beck) Klokov, Novosti Sist. Vyssh. Nizsh. Rast. 1975: 40. 1976; *Stipa eriocaulis* subsp. *austriaca* (Beck) Moraldo and Ricceri, Webbia 58: 110. 2003, nom. illeg.; *Stipa pulcherrima* var. *austriaca* (Beck) Borza, Consp. Fl. Roman.: 29. 1947, nom. illeg. *Stipa pulcherrima* var. *austriaca* Podp., Práce Morav. Přír. Společn. 2: 699. 1926; *Stipa eriocaulis* var. *austriaca* (Beck) Endtm., Wiss. Z. Ernst–Moritz–Arndt–Univ. Greifswald, Math.–Naturwiss. Reihe 11: 148. 1976, comb inval. *Type:* AUSTRIA. Niedersoterreich. Wien Türkenschanze, 4 Jun 1875, *Beck s.n.* (lectotype, PRC digital image!, designatd by Martinovský and Skalický 1969).
Stipa brachyptera Klokov, Novosti Sist. Vyssh. Nizsh. Rast. 1975: 26. 1976. *Type:* UKRAINE. Tauria. Mons Czatyr–dag, 10 et 11 Jul 1956, *Klokov s.n.* (holotype KW).
Stipa pennata subsp. *dvorakyi* Martinovský and Moraldo, Preslia 52: 17. 1980; *Stipa eriocaulis* subsp. *dvorakyi* (Martinovský and Moraldo) Moraldo and Ricceri, Webbia 58: 110. 2003. *Type:* MACEDONIA. Galičica, 15 Jun 1976, *Dvořák s.n.* (holotype, PRC digital image!).
Stipa etrusca Moraldo, Webbia 40: 236. 1986; *Stipa oligotricha* subsp. *etrusca* F.M. Vázquez and M. Gutierrez, Telopea 13: 163. 2011. *Type:* ITALY. Toscana. Alta Valle Tiberina, Colle degli Scopeti, serpentini, 20 Jun 1984, *Moraldo, Voarino and Valbonetti s.n.* (holotype, FI digital image!; isotypes, NAP, RO, Herbario de Moraldo).
Stipa veneta Moraldo, Webbia 40: 238. 1986. *Type:* ITALY. Veneto Laguna di Venezia presso Jesolo: Cavallino alla Duna Vecchia, 10 Jun 1984, *Moraldo and Amici ed Huidobro s.n.* (holotype, FI digital image!; isotypes, FI!, G, NAP, RO, Herbario de Moraldo).
Stipa lithophila P.A. Smirn., Uchem. Zap. Mosk. Univ. 2: 334. 1934; *Stipa lithophila* P.A. Smirn. ex Roshev. in Kom. (ed.), Fl. URSS 2: 741. 1934; *Stipa eriocaulis* subsp. *lithophila* (P.A. Smirn. ex Roshev.) Tzvelev, Novosti Sist. Vyssh. Rast. 11: 18. 1974; *Stipa pennata* subsp. *lithophila* (P.A. Smirn. ex Roshev.) Martinovský, Preslia 44: 18. 1972. *Type:* UKRAINE. Tauria, Jaila, m. Demerdshi, 24 May 1905, *Busch s.n.* (lectotype, LE! designated by Roshevitz, 1932).

Stipa feltrina Moraldo, Lasen and Argenti *Typus:* ITALY. Veneto, M.te Miesna, alla Rocchetta, m 500, 13.06.1985, *Lasen s.n.* (holotype, FI, digital image!).

Herbs 23–80 cm high. Basal leaf 24–82 cm long, green; leaf–sheath minutely pubescent; leaf–blade 13–74 cm long, (0.4)0.5–0.8(1) mm in diameter, convolute, abaxial surface glabrous or minutely scabrous at the base and the remainder glabrous, adaxial surface ribs scabrous or papillae and furrows minutely pubescent, prickles 0.01–0.4 and hairs 0.03–0.21 mm long; ligules (0.5)1–3.5(6.7) cm long. Floriferous culm leaf–blade 15–47 cm long, abaxial surface glabrous, scabrous or with sparsely stiff hairs, adaxial surface totally pubescent or with the ribs scabrous and the furrows minutely pubescent. Glumes (4)5–7(8) cm long. Anthecium (14.2)15.5–20.2(21.4) mm long, (0.8)1–1.3(1.5) mm in diameter. Lemma (10.9)12–18(19.3) mm long, with 6 rows of hairs with the dorsal row absent, with the subdorsal rows fused and the remainder rows free or with 7 rows of hairs with the dorsal and subdorsal ones fused and the remainder rows free (rarely with 8 or 9 rows of hairs), with the ventral rows of hairs always reaching the top of the lemma. Awn (16)21–28(36) cm long. (Fig. 16 a–l; Fig. 10 c_1)

Chromosome Number: 2n= 44, Vázquez and Devesa 1996, Tarnavschi 1970.

Habitat and Distribution: Inhabits steppes, rocky slopes, shrubby meadows, over calcareous soils and more rarely over serpentine, from low meadows up to middle mountains belt, 150 to 2500 m. Particularly abundant in Central, south and west Europe, becoming less abundant towards east Europe. (Fig. 17)

Phenology: Flowering and fruiting from April to August.

Representative specimens examined: ANDORRA. Canillo (Andorre), 42° 35´ N 1° 36´ E, 8 Jul 1981, *Romo 17770* (BR). AUSTRIA. Carinthia: In monte Geisberg, 46° 27´ N 14° 11´ E, 21 Jun/12 Jun 1889, *Dichtl 2897* (PR, W, WU); Gailtaler Alpen. Dobratsch, sudseite auf Schutthalden bei Oberschütt vereinzelt, reichlich an den Felswänden darüber, 46° 35´ N 13° 43´ E, 14 Jun 1964, *Melzer s.n.* (W). Niederösterreich: Hainburger Berge: Braunsberg, SW–Hang (7867/2), 48° 28´ N 16° 20´ E, 24 Jun 1980, *Strudl 22* (W); Wiener Becken: knapp NW Sollenau, 47° 53´ N 17° 16´ E, 23 Jun 1985, *Pokorny and Strudl s.n.* (W); In collibus aridis prope Perchtoldsdorf, 48° 7´ N 16° 16´ E, 19 May 1923, *Rechinger, K. s.n.* (BR, H); Bisamberg, 48° 20´ N 16° 21´ E, 24 May 1886, *Richter s.n.* (NY); Baden–Pfaffstetner Kogel, 48° 2´ N 16° 14´ E, 11 May 1930, *Valentine s.n.* (NY); In graminosis rupestribus prope pagnum Gumpoldskirchen, 48° 3´ N 16° 17´ E, 29 May 1921, *Mayer s.n.* (S); Monte Braunsberg prope Hainburg, 48° 28´ N 16° 20´ E, 2 May 1926, *Rechinger s.n.* (PR). Styria: Pux bei Tenfenbach, 47° 18´ N 14° 18´ E, 14 Jun 1934, *Fest s.n.* (WU). Tirol: Bozen–Gries (Sud Tirol), 47° 3´ N 11° 0´ E, 1908, *Palézieux s.n.* (G); Bozen: Promenade bei Gries, 47° 3´ N 11° 29´ E, 1 Jun 1898, *Dihm s.n.* (M); Tirol. austr. Val di Ledro, 45° 53´ N 10° 45´ E, 17 May 1884, *Porta s.n.* (UPS); Valsertal: 1,2 km SE St. Jodok am Brenner, SE–Hang oberhalb des Gehöftes "Fiedler", 47° 0´ N 11° 30´ E, 28 Jun 1985, *Pokorny and Strudl s.n.* (W). ALBANIA. Gjirokastër: Kreis KorÇa: Mali Thatë, 40° 11´ N 19° 55´ E, 17 Jul 1980, *Krendl, F. s.n.* (C). Shkodër: In Suh Lak ad prios Trijapsi distr. Kuci, 42° 7´ N 19° 35´ E, 4 Jul 1900, *Baldacci 365* (G, M, W). BULGARIA. Pleven. In graminosis siccis prope pag. Lovca distr. Goce Delvec, 2 Jun 1930, *Drenovski s.n.* (W); Pernik distr., montes Konjavska planina, 24 Jun 1971, *Vasák s.n.* (W). BOSNIA. Županjac, 43° 43´ N 17° 13´ E, 18 Jul 1907, *Stadlmann, Faltis and Wibiral s.n.* (WU); 4 miles on road from Gacko to Foča, along Vrba valley, 43° 10´ N 18° 32´ E, 22 Jun 1965, *Melville 65/1406* (K); Hercegovina: In reg alp. infrt. Monte Velez planina, 43° 19´ N 18° 0´ E, 27 Aug 1889, *Murbeck s.n.* (UPS); Jajce, steinige Abhänge des Vrbas–Tales an der Strasse nach Banjaluka, 44° 45´ N 17° 14´ E, 6

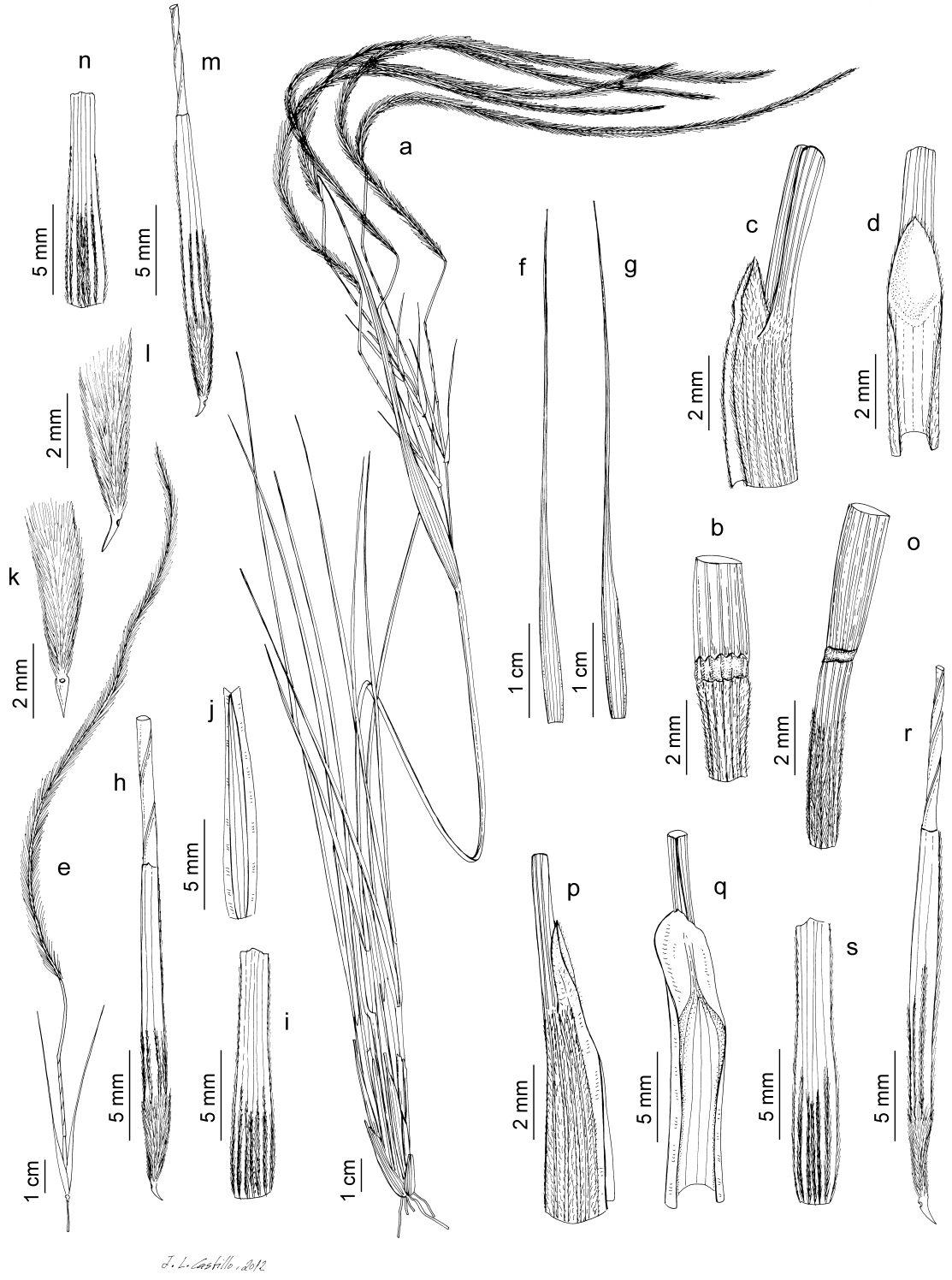

Figure 16. *Stipa eriocaulis* subsp. *eriocaulis*. A, habit; B, floriferous culm node; C, ligule, lateral view; D, ligule, frontal view; E, spikelet; F, upper glume; G, lower glume; H, anthecium and column; I, lemma; J, palea; K, callus, ventral view; L, callus, lateral view. *Stipa eriocaulis* subsp. *lutetiana*. M, anthecium and column; N, lemma. *Stipa dasyvaginata*. O, floriferous culm node; P, ligule, lateral view; Q, ligule, frontal view; R, anthecium and column; S, lemma. [Based on: A–L, *Berger 19935* (BR); M–N, *Bullemont* 9 Jun 1867 (BR); O–S, *Herrero et al. 3206* (MA)].

Jun 1905, *Behrendesen s.n.* (U). CROATIA. Dubrovnik–Neretva: Dalmatien. Auf steinigem Boden an den Hosturzen des Mt Petka auf der Halbeirsd Lapad bei Gravosa, 42° 39´ N 18° 5´ E, 22 May 1926, *bad handwriting* (UPS). Dalmatica: Scoglien. Dubrovnik (Ragisa) Gruz (Gravosa), 42° 39´ N 18° 5´ E, 28 Aug 1929, *Ginzberger s.n.* (WU). Istria: Gebiet des Montes Maggiore, 45° 15´ N 14° 11´ E, 30 May 1909, *Ginzberger s.n.* (WU). Lika–Senj: In litt coat. ad Martinscica, 44° 37´ N 14° 27´ W, 23 May 1894, *Rossi s.n.* (G, GH, JE). Primorje–Gorski Kotar: Stephanie Schutzhaus et Vela Ucka, 45° 18´ N 14° 12´ W, 20–21 Jun 1898, *Saint Lager* (G). Zadar: Scoglien westl. v. Lagosta: Mali Razanak, 44° 18´ N 15° 19´ E, 29–30 May 1911, *Ginzberger and Teyber s.n.* (WU, UPS); Quarner Bucht, Insel Cres/Cherso/Kherscher, SW Cres/Cherso/Kherscher, arn Weg von Lubenice/Lubenizze nach WSW zur Uvala Sv. Ivan/Porto S. Giorgio/Georges–Bucht, 44° 53´ N 14° 19´ E, 16 May 2005, *Starmühler and Starmühler s.n.* (W). Šibensko–Kninska Županija: Hvratska: Gracac– Knin 12 km w Knin, 44° 2´ N 16° 12´ E, 21 May 1989, *Nydegger 31279* (M). Split–Dalmatia: Dalmatinsch–bosnische Grenze: Otoki stani an der Kamešnica, 43° 43´ N 16° 52´ E, 4 Jul 1909, *Handel–Mazzetti s.n.* (WU); Indsel Lukovci (Bacili) bei Lesina, 43° 10´ N 16° 26´ E, 2 May 1913, *Marocvic s.n.* (W). Zadarska Županija: Flora Dalmatica. In declivibus aridis m Velebit inter Podprag et Mali Halan, 44° 17´ N 15° 12´ E, 6 Jul 1905, *Degen s.n.* (W). CZECH REPUBLIC. Jihomoravský Kraj: Pouzdrany steppereservaat in midmoravie, km 2 von Brno, 48° 56´ N 16° 37´ E, 22 May 1959, *Smidt 387* (U). Severocesky: Wr. Nenstadt, 50° 41´ N 13° 42´ E, *Sonklar s.n.* (WU). FRANCE. Alsace: Rcohes calcareis et arides pres de Westhalten (Haut–Rhin), 47° 57´ N 7° 16´ E, 9 Jun 1848, *Becker 689* (JE, S), Haut–RHin, Elzas, prés de Westhalten, 47° 57´ N 7° 16´ E, 1845, *Becker s.n.* (WAG). Auvergne: Juva Francais: Rohers du Fort de l´Ecluse, 46° 28´ N 3° 25´ E, 5 Jun 1851, *Hues du Pavillon s.n.* (H); Tournemire, 45° 3´ N 2° 25´ E, Jun 1905, *Puech s.n.* (H, L). Bourgogne: Velars, 47° 20´ N 4° 53´ E, Jun 1918, *Desplantes 3942* (G, S). Center: France dept. du Cher, 47° 0´ N 2° 30´ E, 7 Jun 1839, *Lambertye s.n.* (BR, C). île–de–France: Fonteinebleau, 48° 24´ N 4° 42´ E, 8 Jun 44, *Bouvier s.n.* (G). Languedoc–Roussillon: Drome, 44° 35´ N 5° 10´ W, 15 May 1925, *Briquet 100* (G); Mas–Saint–Chély (Lozere), Causse Méjean 1500m au SE du village, 44° 16´ N 3° 22´ E, 11 Jul 1972, *Raynal 15338* (BR, C, H); Hérault. Le Caylar, 43° 51´ N 3° 18´ E, 10 Jul 1966, *J. Chr. van Loon 399* (U). Lorraine: Luneville, 48° 36´ N 6° 30´ E, G*aillardot s.n.* (JE). Midi–Pyrénées: 5 km S of Cahors on n 653. Old railway or road now overgrown Curiaria, Oak, Ash, 44° 26´ N 1° 26´ W, 21 Jun 1968, *Nerhour 4560* (K); Ussat (Ariege), 42° 50´ N 1° 37´ E, *Mailhor s.n.* (S); Causse noir bij Revens (Aveyron), 44° 5´ N 3° 18´ E, 19 Jul 1967, *Florschütz 3472* (U); 1 km N va Puylaroque aan de weg naar Bach. Dep. Tarn–et–Garonne, 44° 15´ N 1° 36´ E, 15 Jul 1967, *Sipman 260* (U). Pays–de–la–Loire: Chinon (Indre et Loire), 47° 15´ N 0° 22´ W, 31 May 1873, *Tourlet s.n.* (UPS). Provence–Alpes–Côte d'Azur: Environs de Sault (Vaucluse), 44° 5´ N 5° 24´ E, Jun 1964, *Vinot 4676* (BR); Roches a Tende, 44° 3´ N 7° 35´ W, 24 Jun 1861, *Cosson s.n.* (G); Basses Alpes: ad radices occidentales collis " La Baume" prope oppidum "Sisteron", 44° 12´ N 5° 56´ E, 12 May 1969, *Charpin and Greuter 8267* (G, NY); Les Taillades–Robin (Dep. Vaucluse), pentes séches du Petit–Luberon, au–dessus de Vidauque, 43° 49´ N 5° 5´ E, 4 May 1982, *Rastetter 11985* (BR, C, H, L, LD); Bacédère du Pelvaux à Qurières Route Mont Dauphine–BrianÇon, 44° 49´ N 6° 35´ E, Jun 78, *Sotiaux s.n.* (BR); La Sainte Baume Créte rocheuse calcaire prés du Saint Pilon, 43° 20´ N 5° 45´ E, 29 May 1958, *Lauvalrée 9642* (BR, UPS); Prope Tarascon, 43° 48´ N 4° 40´ W, May 1839, *Kugel s.n.* (GH); Provence–Alpes–Côte d'Azur: Comps–sur–Artuby, Var, 43° 43´ N 6° 30´ E, 6 Jul 1969, *Halliday 161/69* (C); St. Baume–Mdhelling–kalk–Foret dominiale. Departement Var, 43° 25´ N 6° 52´ E, 29 May 1958, *Hekking 333* (U). Rhône–Alpes: Clapière, 44° 30´ N 5° 13´ W, Jun 79, *Sotiaux s.n.* (BR); Ambronay (Ain), 46° 0´ N 5° 21´ W, 3 Jun 1880, *Fray s.n.* (UPS); Grenoble, 45° 10´ N 5° 43´ E, 13 Jul 1883, *Beaudouin s.n.* (S); Isére. Romanche–Tal bei Bourg–d´Oisans, 45° 5´ N 5° 43´ E, 14 Jun 1967, *Roessler 5894* (M); Brette pied de la montagne de la cervelle. Drême, 44° 35´ N 5° 21´ E, Jun 1967, *Sotiaux s.n.* (MA); Dept. Savoie, between Lanslebourg and Lanslevillard, 45° 17´ N 6° 55´ E, 17 Jul 1954, *Jacobs 3992* (S). GERMANY. Baden–Württemberg: Xerobrometum am Sporn des Isteiner Klotzes, 49° 4´ N 9° 35´ E, 1 Jun 1991, *Dunkel s.n.* (M). Bayern: Roth–Berg b. Himmelstadt a. Main, 49° 55´ N 9° 48´ E, 2 Jun 1923, *Oberneder s.n.* (BR); Gravosa; an der Wasserleitung bei Anunciata, 49° 30´ N 9° 30´ E, *Baenitz s.n.* (BR, JE, W). Thuringia: Ruppberg bei Ofen, 50° 39´ N 10° 22´ E, 6 May 1915, *Schiller s.n.* (C); Regenberg, 50° 50´ N 10° 32´ E, 6 May 1915, *Neuman s.n.* (C). GREECE. Anatolikí Makedonía kai Thráki: Mountain Falacro Drama district, 41° 15´ N 24° 15´ E, 15 Jun 1982, *Drossopoulos 618* (C); Prov. Dhrama: in laterre boreo–orientali montis Meniki (Boz dag Serron) supra pagum

Mikropolis, 41° 12´ N 23° 46´ , 20 Jul 1978, *Greuter 16155* (C, MA); Nom Kavalás, Ep Pangeaou: Mt Pangeon, summit area, c. 1 km E of the ERT station, 40° 55´ N 24° 5´ E, 5 Jul 1985, *Strid and Uotila 33897* (H). Epirus: Prov. Joannina, Timfi Oros: vom Talboden auf dem Weg zur Astraka–Gamila–Abzweigung, 39° 58´ N 20° 48´ E, 24 Jul 1985, *Burri and Krendl s.n.* (W). HUNGARY. Fejér: Pilisvörösvár: Dolomithange zw. Piliszintiva´n und Nagyszinás bei Nagykovási, 47° 35´ N 18° 53´ E, 22 May 1963, *Schneider s.n.* (JE); Vértes–Geb. Csákvár. Balog–volgy, 47° 23´ N 18° 27´ E, 28 May 1963, *Schneider s.n.* (JE). Pest: Budapest: Farkasvölgy, 47° 56´ N 19° 13´ E, 24 May 1914, *Szabó s.n.* (S); Kom Pest. Nagykovacsi, Nagyssenas, 47° 39´ N 19° 1´ E, 28 May 1963, *Bisse s.n.* (JE). Primorsko–Goranska Županija: In clivibus lapidosis aridis ad pagum Martinsčiča, 44° 49´ N 14° 21´ , 2 Jun 1902, *Degen 254* (GH, W, WU). Veszprém: Tapolca. Szentgyörgy–hegy, 46° 56´ N 17° 42´ E, 29 May 1963, *Schneider s.n.* (JE); Eszak Bakony; ca. 500 m N oberhalb Czór, E Várpalota, 47° 11´ N 17° 50´ E, 30 May 1985, *Krendl s.n.* (W); Deli Bakony; ca. 10 km E Vezsprém, S Hajmásker an den N–Hängen gegen das Sed–Tal., 46° 59´ N 17° 39´ E, 24 May 1985, *Krendl s.n.* (W). ITALY. Abruzzo: L´Aquila, pr. Santo Stéfano de Sessanio, 42° 20´ N 13° 37´ E, 29 Jun 2002, *Aedo et al. 7999* (MA); Aprutium. In ditiane pagi Collelongo, loco dicto "Monte Annamunna", 41° 53´ N 13° 34´ E, 2 Aug 1907, *Grande 58* (W). Basilicata: Prov. Cosenza: Waldstufe des Mt. Pollino an der Strabe zum Col de Dragonet, 39° 55´ N 16° 11´ E, 1 Jun 1968, *Merxmüller and Lippert 23780* (M). Calabria: ca. 2–3 km W Oberhalb der Strabe nach Castrovillari, gegem die czo della Bango, 39° 49´ N 16° 12´ E, 17 Jul 1980, *Burri and Krendl s.n.* (W). Campania: Polla. M. Alburni, 40° 33´ N 15° 19´ E, 22 Jun 1978, *Moraldo s.n.* (G). Emilia–Romagna: Monte Gazzo a Sestri presso Genova, 44° 39´ N 9° 43´ E, 15 May 1871, *Piccone s.n.* (BR). Friul–Venecia Julia: Val d´Aoste vallee de Valpelline, 45° 50´ N 7° 20´ E, 25 Jun 1975, *Onraedt 75.I.1068* (BR); Trieste: auf Felsenwiesen bei Duino, 45° 46´ N 13° 36´ E, 3 May 1951, *Höpflinger s.n.* (S, BR); Regio tergestina, in lapidosis graminosis prope foveolam dictam Orlek, 45° 41´ N 13° 49´ E, 19 May 1972, *Poldini 7269* (C, G, H, L); Monte Spoccalo bei Triest, 45° 40´ N 13° 46´ E, 23 May 1880, *Berk 20* (W). Gorizia: Istrien. Golf von Triest, E Trieste/Triest, Pesse/Pesek oberhalb der Kirche, 45° 37´ N 13° 53´ E, 23 May 2005, *Starmühler s.n.* (W). Liguria: Lugano–Irakien: Paradiso: San Martino, 44° 20´ N 9° 8´ E, 10 Jun 1925, *Bergir s.n.* (S). Lombardia: Punta Bunecolo: Pesntesroch y Marone, 45° 44´ N 10° 5´ E, 14 May 1910, *Chenevard s.n.* (G); Gardasee, an der Ponalestrabe bei Riva, 45° 38´ N 10° 40´ E, 18 May 1902, *Renner s.n.* (M); Distretto Insubrico, Garda, 46° 7´ N 10° 21´ E, 18 May 1972, *Folkeson s.n.* (S); Lecco, in declivibus ardis lat. occid. montis St. Martino secundum viam inter Lecco wt Abbadia, 45° 55´ N 9° 19´ E, 16–17 Apr 1921, *Rossi 2612* (GH); Marche: Apennino modense e zone limitrofe, 42° 56´ N 13° 14´ E, 25 May 1949, *Mori s.n.* (FI); Esino am Comer See, 43° 39´ N 13° 22´ E, 9 Jun 1908, *Ipse s.n.* (S). Piemonte: Valle d´Aosta. NE Echarlod (se La Salle), 45° 45´ N 7° 4´ E, 31 May 1999, *Müller 6794* (JE); Susa–Tal, S–Seite, 4 km SE Susa, 45° 8´ N 7° 3´ E, 21 May 1993, *Ephedra Reis* (W). Puglia: Gargano, Strabe von Mt. San Angelo nach Manfredonia, 41° 38´ N 15° 55´ E, 22 May 1963, *Damboldt s.n.* (M). Toscana. Firenze. Prato 5 Km N of Prato, Monte Ferrato, 43° 55´ N 11° 4´ E, 25 May 1977, *Uotila 26049* (H); Alta Valle Tiberina. Monte Murlo, 43° 7´ N 11° 24´ E, 14 May 1935, *Sermolli s.n.* (W); Monte Ferrato, 43° 55´ N 11° 4´ E, 20 Jun 1984, *Moraldo s.n.* (FI), Poggio Alle Fate (GR), 43° 30´ N 10° 25´ E, 17 Jun 1892, *Foffi s.n.* (FI). Trentino–alto Adigio: Bozen, 46° 31´ N 11° 22´ E, *Hausmann 1146* (BR). Umbria: Marmore mountain, 42° 33´ N 12° 43´ E, 3 Jun 1892, *Lochenies s.n.* (BR); Trento: bei dem Castello Penede südl. Nago, 45° 53´ N 10° 53´ E, 17 May 1975, *Lewejohann 75–057* (GOET). Veneto: Cavallino (Jesolo), 45° 27´ N 12° 29´ E, 10 Jun 1984, *Moraldo, Amici and Huidobro s.n.* (G). Valle d'Aosta: Aosta: Parco Nazionale Gran Paradiso: tussen Valnontey en Rifugio Vittorio Sella (5 km. ten ZW van Cogne), 45° 37´ N 7° 21´ E, 29 Jul 1966, *Stud. Biol. Rheno–Trai. in itinera 66–2838* (U); Aostatal. zwischen Breil und Chambave W Châtillon, 45° 45´ N 7° 36´ E, 1–12 Jun 1980, *Polatschek s.n.* (W); Trockenhang südlich Saint Vicent, 45° 45´ N 7° 39´ E, 10 Jun 1962, *Doppelbaur s.n.* (M). Veneto: In apricis in Baldo supra Castelleto, 45° 56´ N 11° 32´ W, 31 May 1901, *Haussknecht s.n.* (G, JE). MACEDONIA. Skopje: Hänge hinter dem Bergwerk von Raduša, 42° 5´ N 21° 12´ E, 30 May 1968, *Bäbler and Quasdorf 849* (B). Toplica: Slavnik: karstige Hänge, 43° 1´ N 21° 39´ E, 30 May 1966, *Podlech 13128* (H), Vardar: Macedon. centr. In saxosis calcareis inter Rosždan et Allchar, 41° 9´ N 21° 56´ E, *Dörfler 393* (WU). MONTENEGRO. Katunska nahija, loco Velestovo, 42° 31´ N 18° 57´ E, Jun 1900, *Rohlena s.n.* (PR). ROMANIA. In calcareis "Kleiner Hangestein" prope Coronam in Transsilvania, May 1905, *Römer s.n.* (H). SERBIA. Nord Albanien: Umgebung von Shodra. Auf dem Groden

Bardanjolt, 42° 5´ N 20° 53´ E, 12 Jun 1916, *Janchen s.n.* (WU). SLOVAKIA. Trenčín: In collibus Čachtické kopce, haud procul ab oppido Nové Mesto nad Váhom, 48° 43´ N 17° 47´ E, Jun 1935, *Weber s.n.* (S, W); Nové Mesto: In stepposis calcareis sub ruinam arcis Cachtice supra vicum Višňové., 48° 43´ N 17° 47´ E, 22 May 1965, *Černoch 14384* (C, LD). SLOVENIA. Obalnokraska: Karst: Karstwiese nordöstlich von Divača, 45° 41´ N 13° 58´ E, 29 May 1955, *Merxmüller and Wiedmann s.n.* (M). Nördlischt von Divaca, 45° 41´ N 13° 58´ E, 28 May 1955, *Wiedmann s.n.* (M); 30 km W of Postojna, Hrpelje, 45° 36´ N 13° 56´ E, 11 Jun 1971, *Uotila 32428* (H, UPS). SPAIN. Albacete: Sierra de Taibilla, Las Cabras, 38° 4´ N 2° 24´ W, 17 Jul 1974, *Charpin and Fdz. Casas 10577* (G). Castellon: Peñagolosa (CS), 40° 13´ N 0° 21´ W, 9 Jun 1999, *Jiménez, J. et al. 16* (MA). Cuenca: Mogorrita. Montes Universales, 40° 20´ N 1° 46´ W, 22 Jul 1979, *López, G. 2101* (MA). Huesca: Jaca, Monasterio de San Juan de la Peña, 42° 30´ N 0° 39´ W, 9 Jul 1990, *Garcia, S. and Vázquez, F.M.* (G); Ibón de Plan, 42° 30´ N 0° 21´ W, 17 Aug 1985, *Gómez, D. s.n.* (JACA); San Juan de la Peña, 42° 31´ N 0° 38´ W, 2 Jul 1973, *Fanlo, R. s.n.* (JACA); Lavasar, Saravillo, 42° 33´ N 0° 15´ W, 30 Jul 1975, *Montserrat, P and Villar s.n.* (JACA); Nocito, 42° 19´ N 0° 15´ W, 23 Jun 1992, *Sese and Villar s.n.* (JACA); Jaca. Cretas de Oroel, 42° 31´ N 0° 31´ W, 8 Jul 1971, *Montserrat, P. 4331/71* (JACA). Lérida: Valle de la Segre. Seo d´Urgel, 42° 21´ N 1° 27´ E, Jul 1847, *Bourgeau 271* (UPS, W). SWITZERLAND. Berna: Fuhre, 46° 29´ N 7° 34´ E, 27 Jul 1883, *Hult s.n.* (H). Graubünden: Föhrenbez. Oberhalb Zuoz, 46° 36´ N 9° 57´ E, Jul 1926, *Scherrer 905* (C, PR, U). Jura: Onsingen, Roggesfluh, 47° 17´ N 7° 44´ E, 7 Jun 1907, *Hülphers s.n.* (S). Obwallis: Fohrenwald bei Stalden, 46° 53´ N 8° 14´ E, 7 Aug 1950, *Merxmüller s.n.* (M). Valais: Vercorin, 46° 15´ N 7° 31´ E, 21 Jul 1947, *Duc s.n.* (BR); Östl. Bahnhif Salgesch, 46° 19´ N 7° 35´ E, 2 Jun 1941, *Koch s.n.* (NY); Mont d´Orge bei Sitten, 46° 14´ N 7° 21´ E, 6 May 1934, *Koch s.n.* (NY, S); La Bâtiaz, westlich Martigny (Kanton Wallis), 46° 6´ N 7° 5´ E, 19 May 1957, *Berger 19936* (BR, H); Zermatt, 46° 1´ N 7° 45´ E, 8 Aug 1887, *Petit s.n.* (C); Ovronnaz. L´ardeñaz, 46° 12´ N 7° 10´ E, 7 Jul 1987, *Saintenoy–Simon s.n.* (BR); Liez, 46° 10´ N 7° 26´ E, 10 Jul 1980, *Berghen s.n.* (BR); Sion (Rhonedal), 46° 14´ N 7° 21´ E, 19 May 4929, *Boom 5346* (L); Bagnes: rocher bordant le chemin le Cotterg Cries, 46° 5´ N 7° 13´ E, 19 Jul 1980, *Lauvalrré 22614* (BR). TURKEY. Ankara, 25 Jun 32, *Kotte s.n.* (K). Niğde: N Hang des Taurus, Berge oberhalb von Madenköy, 37° 27´ N 34° 37´ E, 31 Jul 1970, *Spitzenberger 172* (W). UKRAINE. Krym: Palicastro above Nikita, 44° 32´ N 34° 14´ E, 16 May 1984, *Borodin s.n.* (LE)

7b. *Stipa eriocaulis subsp. lutetiana Scholz*

Stipa eriocaulis subsp. *lutetiana* Scholz, Willdenowia 4: 299. 1968; *Stipa pennata* var. *lutetiana* F.M. Vázquez and M. Gutierrez, Telopea 13: 161. 2011. *Type:* FRANCE. Fontainebleau, 20 Jun 1886, *Franchet s.n.* (holotype, P)
Stipa eriocaulis Borbás subsp. *carnicolica* Jogan, Hladnikia 11: 26. 2001, *Type:* SLOVENIA. In pratis montis Vremščica supra pagum Britof in valle fluvii Reka, 26 Jun 1953, *Martinčič s.n.* (holotype, LJU; isotype, B digital image!, TSB).
Stipa pennata subsp. *slovaca* F.M. Vázquez and M. Gutierrez, Telopea 13: 161. 2011. *Type:* SWITZERLAND. Verbois á Tajomas, 30 May 1924, *Briquet 3149* (holotype, BM; isotype, G!).

Herbs 25–57 cm high. Basal leaf 24–49 cm long, green; leaf–sheath minutely pubescent; leaf–blade 19–42 cm long, (0.4)0.5–0.72(0.76) mm in diameter, convolute, abaxial surface glabrous or minutely scabrous at the base and the remainder glabrous, adaxial surface ribs scabrous or papillae and furrows minutely pubescent, prickles 0.01–0.4 and hairs 0.03–0.21 mm long; ligules 0.7–3.1(3.4) cm long. Floriferous culm leaf–blade 4–13 cm long, abaxial surface glabrous, scabrous or with sparsely stiff hairs,

adaxial surface totally pubescent or with the ribs scabrous and the furrows minutely pubescent. Glumes (4.6)5–6.7(7.5) cm long. Anthecium (15.4)16.1–18.9(19.6) mm long, (0.9)1–1.3(1.4) mm in diameter. Lemma (12.1)12.3–14.6(15.4) mm long, with 6 rows of hairs with the dorsal row absent, with the subdorsal rows fused and the remainder rows free or with 7 rows of hairs with the dorsal and subdorsal ones fused and the remainder rows free, with the ventral row of hairs ending (1.9)2.3–5 mm below the top of the lemma. Awn (21.5)22.9–30 cm long. (Fig. 16 m–n; Fig. 10 c_2).

Chromosome Number: unknown

Habitat and Distribution: Inhabits steppes, rocky slopes and open communities with shrubs, from sea level up to middle mountain belt at 1600 m. Mainly found at southeast France and from the regions of Istria and Dalmatia (Croatia). As well, one specimen from Italy and one from Switzerland close to France, and one from Slovenia and another one from Serbia close to Croatia have been studied. (Fig. 17).

Phenology: Flowering and fruiting from May to July.

Representative Specimens Examined: BOSNIA AND HERCEGOVINA: Dinarische Alpen: Am Südwesthäng des gebirges in der Gegend der Doline Kozja jama südwestl d. Troglav, 43° 56´ N 16° 35´ E, 3 Jul 1907, *Janchen and Watzl s.n.* (WU). CROATIA Istria: Gebiet des Monbtes Maggiore, 45° 15´ N 14° 11´ E, 30 May 1911, *Ginzberger s.n.* (WU). Primorje–Gorski Kotar: Drŭf d. In fel Veglia im Luarmero, 45° 1´ N 14° 34´ E, 6 May 1869, *Loebisch s.n.* (WU); In monte Trsat, 45° 20´ N 14° 27´ W, 24 May 1894, *Rossi 5782* (JE). Zadar: Dalmatien: Dinarischen Alpen; Westhang des Pitomi vrh westlich der Dinara, 44° 5´ N 16° 21´ E, 12 Jun 1908, *Janchen s.n.* (WU). FRANCE. Île–de–France: Rosheres de Villetard a Malesherber, 48° 18´ N 2° 25´ E, 9 Jun 1867, *Bullemont s.n.* (BR); Lardy, 48° 31´ N 2° 16´ E, 14 Jun 1863, *Boissier s.n.* (G); Bouches de Rhône: Meyrenil, 48° 18´ N 2° 25´ E, 17–26 May 1912, *Delmas 1968* (BR). Languedoc–Roussillon: Dept. Aveyron; Causse noir near Revens, 44° 5´ N 3° 18´ E, 19 Jul 1967, *Florschütz 3472* (NY); Mordstlicj Col de Perjuret Richtung, Serre Porátu, 44° 12´ N 3° 30´ E, 23 May 1954, *Rothlisberger s.n.* (G). Midi–Pyrénées: Les Taillades–Robion (Dep. Vaucluse) pentes seches su Petit–Luberon, au–dessus de Vidauque, 42° 44´ N 0° 0´ W, 4 May 1982, *Pitard s.n.* (G); Hautess–Pyrenees. Environs de Gavarnie: Valee d´Ossoue, 42° 44´ N 0° 0´ E, Jul 1904, *Pitard s.n.* (S); Le Rozier (Lozere), 43° 57´ N 3° 11´ E, 17 Jun 1962, *Witte s.n.* (BR). Provence–Alpes–Côte d'Azur: Les Taillades–Robin (Dep. Vaucluse), pentes séches du Petit–Luberon, au–dessus de Vidauque, 43° 49´ N 5° 5´ E, 4 May 1982, *Rastetter 11985* (L); Com militare de Conjuers, col du Bel Homme, 43° 49´ N 5° 5´ E, 21 Jun 1996, *Billiet and Jadin s.n.* (BR); Massif de la St. Baume beim Hotel Miremonts (Pland´Aups), 43° 27´ N 5° 51´ E, 3 Jun 1959, *Landolt and Müller s.n.* (NY); Gorge du Verdon, 43° 44´ N 6° 21´ E, 24 May 1977, *Magin s.n.* (W). Rhône–Alpes: Fontaine, prés Grenoble, 45° 10´ N 5° 43´ E, 2 Jul 1879, *Pellat, A. 2663* (G); Loyettes, 45° 46´ N 5° 12´ E, Jun 1983, *Delyosalle s.n.* (BR); C.W de St Baudille Gorges de Verbois, 44° 47´ N 5° 46´ E, 27 May 1921, *Briquet 2254* (G). ITALY. Valle de A´osta: Monte delle Marmore, 45° 44´ N 7° 37´ E, 3 Jun 1892, *Lochenies and Boon s.n.* (BR). SLOVENIA. Notranjskokraska: Carniolia. In locis lapidosis apricis prope pagum Vreme in valle Reka, 45° 39´ N 14° 3´ E, Jun, *Justin 222* (WU).

Notes: Probably, *S. eriocaulis* is one of the most common and widespread species in Central Europe. As is evident in the synonymy listed above, *S. eriocaulis* is a variable species. However it exhibit some constant features, which made this species distinguishable from other species, such as the basal leaf–blade adaxial surface with scabrous or papillae ribs and minutely pubescent furrows, the abaxial surface is glabrous or minutely scabrous at the base an the remainder glabrous, basal leaf–sheath usually pubescent and the dorsal lemma row usually absent. Most similar in this respect and oftenly found in Central Europe is *S. pulcherrima*, which similarity has led to their

missidentificaction in their contact areas. Relation and differences of these taxa are discussed under the former species.

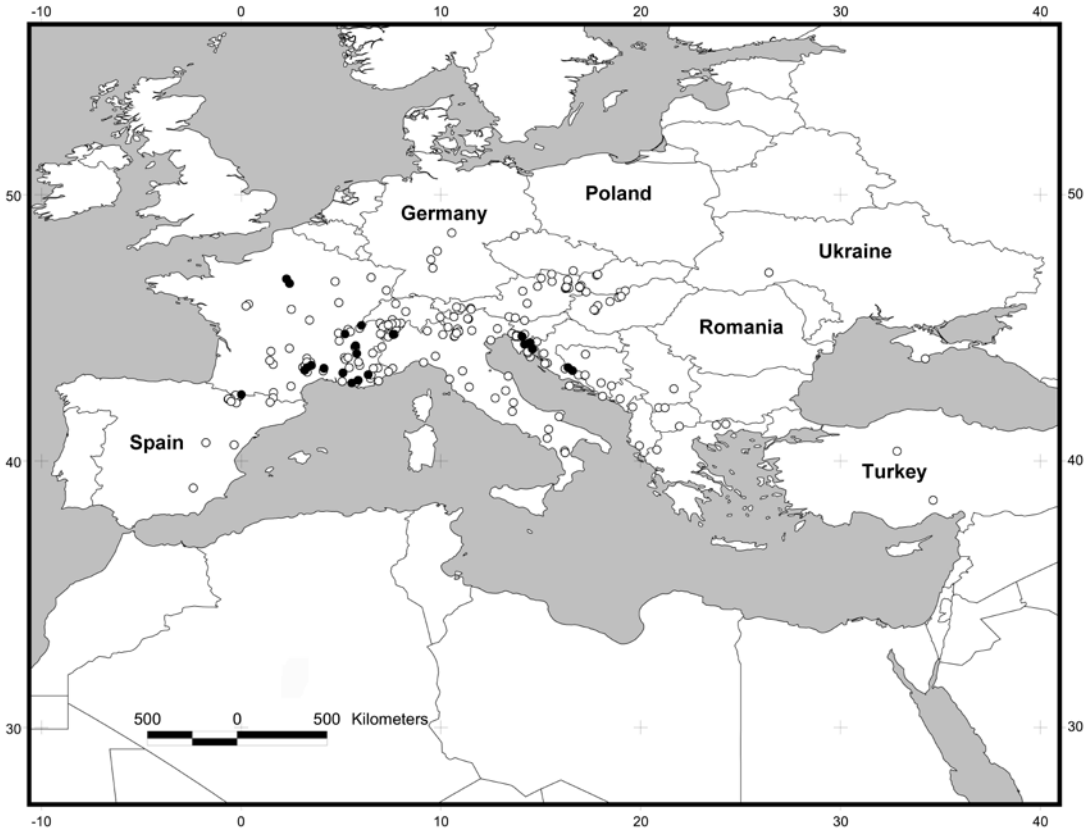

Figure 17. Distribution map: *Stipa eriocaulis* subsp. *lutetiana* (●); *S. eriocaulis* subsp. *eriocaulis* (○).

Throughout its geographically range, its morphology is variable, especially what respect the size of the spikelets, the column ornamentation, the length of the lemma ventral rows and the basal leaf ornamentation, which has led to the description of many new species and subspecies. Specimens with short spikelets (lemma (13)15–16(17) mm long and awn (16)19–22(24) cm long) have been called *S. eriocaulis* subsp. or var. *austriaca* (Endtamann 1962; Martinovský 1967; Morariu 1972; Connert 1992; Moraldo and Ricceri 2003), whereas specimens with longer spikelets (lemma (19)20–22(23) mm long and awn (25)26–29(32) cm long) and glume ciliate have been called *S. eriocaulis* subsp. *dvorakyi* (Martinovský and Moraldo 1980 (sub *S. pennata* subsp. *dvorakyi*); Moraldo and Ricceri 2003). As well as other widespread species (*S. caucasica, S. pennata* L., *S. capillata* L. *S. capensis* Thunb.) the size of the spikelets is highly variable. Additionally, no correlation between geographically or ecologically patterns and spikelets size have been found.

Smirnow (1934) published the name of *S. lithophila* without *a Latin diagnosis*. In the same year, Roshevitz (1934) validly published the name. More recently, Tzvelev (1974) noticed the relationship of this taxa with *S. eriocaulis*, from which can be distinguished by having the column scabrous instead glabrous, and placed it as subspecies. During our study, all the specimens studied from Crimea exhibit a scabrous column; furthermore, this character is sporadically found in the whole geographical

range of the species, and in consequence the taxa is placed in the list of synonymy of *S. eriocaulis* subsp. *eriocaulis*.

More recently Moraldo (1986) described two new species endemic of Italy: *Stipa etrusca*, which grows in Serpentines and mainly distinguished from *S. eriocaulis* by having the columns scabrous, the basal leaf–blade abaxial surface scabrous and the glume ciliate, whereas *S. eriocaulis* has the column glabrous, the basal leaf–blade abaxial surface glabrous and the glume ciliate. The second species is *S. veneta*, endemic of the Venice Lake and mainly distinguished from *S. eriocaulis* by having shorter lemma (12–16 vz. 16–20 mm long), by having the basal leaf–blade abaxial surface scabrous instead glabrous and longer glumes (6–9 vz.4–5 cm long). After studying specimens identified by Moraldo as *S. etrusca* and *S. veneta*, they exhibit the basal leaf minutely scabrous at the base and the remainder glabrous, as well as many of the specimens of *S. eriocaulis* studied. The ciliate glume appears indistinctly in most of the species of the subsection *Pulcherrimae*. Additionally, *S. eriocaulis* is a widely distributed species and morphologically variable, and the lemma and glumes size of *S. veneta* full inside the morphological variation of *S. eriocaulis*.

Commonly, *S. eriocaulis* has the ventral rows of the lemma almost reaching the apex. However, Scholz (1968) described S. *eriocaulis* subsp. *lutetiana* endemic of France mainly characterized by having the ventral rows ending at least 2 mm before the lemma apex. More recently, Jogan (2001) described *S. eriocaulis* subsp. *carnicola* endemic of Slovenia and which also has the ventral rows of hairs ending 3–4 mm below the lemma apex. Both taxa have no morphological differences and are gathered under *S. eriocaulis* subsp. *lutetiana* (the priority name) in this paper. Beside south France and Slovenia new specimens have been found in Switzerland and Italy close to France and in Croatia, close to Slovenia.

8. Stipa dasyvaginata Martinovský

Stipa dasyvaginata Martinovský, Anales Inst. Bot. Cavanilles 27: 61. 1970; *Stipa pennata* subsp. *dasyvaginata* (Martinovský) O. Bolòs and Vigo, Fl. Països Catalans 4: 546. 2001. *Type:* SPAIN. Sierra Nevada, 1873, *Winkler s.n.* (holotype, PRC?).
Stipa dasyvaginata subsp. *apenninicola* Martinovský and Moraldo, Preslia 52: 15. 1980; *Stipa apertifolia* subsp. *apenninicola* (Martinovský and Moraldo) F.M. Vázquez and Devesa, Lagascalia 18: 323. 1996. *Type:* ITALY. Lazio, M. Autore, rpi e xerogramineto sopra e sotto il Santuario della SS. Trinità, 11 Jun 1977, *Moraldo, Carlevaris and Meuti s.n.* (holotype, NAP).
Stipa dasyvaginata subsp. *longiglumis* H. Scholz, Willdenowia 19: 131. 1989; *Stipa apertifolia* subsp. *longiglumis* (H. Scholz) F.M. Vázquez and Devesa, Lagascalia 18: 323. 1996. *Type:* ALGERIA. NO, Djebel Megriss (N Setif) , Fels–und Weide–triften, 11 Jul 1983, *Scholz and Baillargeon 95* (holotype, B!).
Stipa rigida Martinovský Preslia 39: 273. 1967. *Type:* ITALY. Vallepietra alla S. Trinita in Latio, *no author* (holotype FI).

Stipa pennata var. *breviglumis* Maire, Fl. Afrique N. 2: 71. 1892; *Stipa jacobsii* F.M. Vázquez, Telopea 13: 159. 2011. *Type:* ALGERIA. Aures et Djurdjura, 11 Jun 1892, *Trabut s.n.* (holotype, MPU!).

Herbs 32–73 cm high, perennial caespitose; branching intravaginal. Culms 2–3 noded, nodes glabrous, violet or brown; culm internodes usually pubescent or scabrous. Basal leaves 26–60 cm long, green and occasionally pruinose; leaf–sheath minutely pubescent, usually ciliate, cilia (0.1)0.2–0.67(0.72) mm long; leaf–blade 19–44 cm long, (0.45)0.5–075(0.85) mm in diameter, convolute, abaxial surface completely scabrous or scabrous at the base and the remainder glabrous, adaxial surface with ribs scabrous or papillae and furrows minutely pubescent, prickles 0.01–0.4 and hairs (0.02)0.05–0.12(0.2) mm long; ligules (1.5)1.7–3(4) cm long, rounded, obtuse, or acute, pubescent or scabrous, usually ciliate, cilia (0.01)0.03–0.9(1.5) mm long. Floriferous culm leaves 26–45 cm long; leaf–sheath 20–32 cm long, totally scabrous or scabrous near the leaf–blade and the margin and the remainder glabrous, margins usually glabrous; leaf–blade 4–14 cm long, (0.2)–0.4–0.7 mm in diameter, abaxial surface glabrous or scabrous, adaxial face minutely pubescent or with the ribs scabrous and the furrows minutely pubescent, prickles 0.01–0.04, hairs 0.06–0.18 mm long; ligules (1.76)2.8–6.7(7.4) mm long, acute, rounded, obtuse or irregular, usually scabrous or pubescent, margins and tip usually ciliate, cilia 0.05–0.63(0.85) mm long. Panicle 18–50 cm long, contracted, exerted or partially enclosed by the upper leaf–sheath, 2–3 noded; basal internode (2)3.2–7.7(8.2) cm long, usually pubescent; branches (1.4)2.2–4.2(6.6) cm long, patent or ascending, setaceous, setae (0.3)0.4–0.9(1.6) mm long; basal nodes with (1)2 branches with 1(2) spikelets each. Glumes subequal, lanceolate, long acuminate, glabrous sometimes with the central nerve ciliate, cilia 0.12–0.74 mm long, green with the margins and tip hyaline, the lower (5.5)6.8–8.9(9.3) cm long and 3–5(7) nerved, the upper (5)6.4–8.3(8.9) cm long and 5–7(8) nerved. Anthecium (18)18.9–23.2(23.6) mm long, 0.9–1.6(1.9) mm wide, fusiform, coriaceous, green, brown or pale brown; lemma (13.8)14.5–18.1(18.6) mm long, near the apex glabrous, with 6 rows of hairs with the dorsal row absent with the subdorsal rows fused and the remainder rows free or with 7 rows of hairs with the dorsal and subdorsal ones fused and the remainder rows free, the ventral row reaching the top, the dorsal row absent or measuring 1/4–1/3 the length of the lemma, the subdorsal longer than the dorsal row, the lateral rows always longer than dorsal and subdorsal rows with patent or appressed hairs 0.5–0.8(0.9) mm long; callus (3.8)4–5.2(5.4) mm long, acute, curved, villous with hairs (2)2.2–2.9(3.6) mm long on the ventral face and (0.9)1.1–1.7(1.8) mm long on the dorsal face, scar elliptic to rounded, peripheral ring 1–1.3(1.4) mm long, 0.3–0.43 mm wide (ratio wide/length= (0.28)0.29–0.35(0.41)); palea (13.4)14.2–17.3(18.3) mm long, lanceolate, margins and tip hyaline, dorsally 2–nerved, between the two nerves papillae or glabrous, margins glabrous and tip usually ciliate, rarely with a dorsal row of hairs 1/2 the length of the palea, green or brown pale; lodicules 3, equal or subequal, with the dorsal ones slightly longer or shorter than the ventral one, acute, lanceolate or linear lanceolate, membranous, glabrous or the dorsal lodicules ciliate at the apex, dorsal lodicules (2.4)2.8–4.3(4.5) mm long, ventral lodicule (2.5)2.6–3.8(4.2) mm long. Awn (23)24–

32(36) cm long, bigeniculate; column (5.2)6.2–8.6(9) cm long, base 0.6–0.8 mm in diameter, twisted, brown or brown and green, usually glabrous; geniculation (1.5)1.7–2.5(2.8) cm long, scabrous with sparsely hairs 0.3–2 mm long; seta (15)18–25(28) cm long, (ratio column length/seta length = (0.25)0.27–0.4(0.5)), flexuous, plumose, hairs in lower part 4–6.2(6.5) mm long. Anthers (7)8–11(12) mm long, usually yellow, with scattered hairs. Ovary glabrous, styles two. Caryopsis (9.8)10.2–12.9(13.4) mm long, fusiform; embryo (1.5)1.6–2.8(2.9) mm long. (Fig. 16 o–s; Fig. 10 d)

Chromosome Number: 2*n*= 44 Moraldo 1986 sub *S. dasyvaginata* subsp. *apennenicola*.

Habitat and Distribution: Inhabits calcareous soil from lowlands up to mountains peak, from 300–2400 m. Endemic from the mountains of south Spain and the Atlas range of Morocco and Algeria and at lowlands and mountains of Italy. (Fig. 18).

Phenology: Flowering and fruiting from May to July.

Representative Specimens Examined: ALGERIA. Algerie, 23 May 1901, *Trabut s.n.* (G, LD, MA); AIN DEFLA: Lalla Khadidja (Djurjura), 36° 20´ N 4° 10´ E, 26 Jun 1883, *Trabut s.n.* (G); Sud de la Khadidja, 36° 20´ N 4° 10´ E, 27 Jun 1882, *Trabut 243* (W). M'SILA: Aurès, Mont Chélia, 35° 19´ N 6° 39´ E, 11 Jul 1892, *Trabut s.n.* (MPU). SÉTIF: Algerien. NO, Djebel Megriss (N Setif) , Fels–und Weide–triften, 36° 19´ N 5° 20´ E, *no collector* (MA). ITALY. ABRUZZO: Prov. L´Aquila: Gola di San Venanzio, zw. Castell Vechio und Raiano, 42° 6´ N 13° 49´ E, 15 May 1972, *Leute s.n.* (W). LAZIO: Crete vetta M. Revole (M. Arunci–LT), 41° 20´ N 13° 17´ E, 22 May 1983, *Moraldo s.n.* (WU). MARCHE: Mt Priore alli opri, 42° 56´ N 13° 14´ E, Jun 1844, *Morzialetti s.n.* (FI). MOROCCO. MARRAKECH–TENSIFT–EL HAOUZ: Alto Atlas, Oukaïmeden alrededores del pueblo, 31° 12´ N 7° 51´ W, 30 Jun 2006, *Herrero et al. 3206* (MA); Alto Atlas, Oukaïmeden alrededores del pueblo, 31° 12´ N 7° 51´ W, 30 Jun 2006, *Herrero et al. 3225* (MA). SOUSS–MASSA–DRAA: Hoher Atlas Mgoine Marokko: AiA Bougoummer, 30° 32´ N 9° 25´ W, Aug 1951, *Rauh 335* (M). TAZA–AL HOCEIMA–TAOUNATE: In Atlantis montibus Bou–Iblan: Tizi–n–Tazount, 33° 39´ N 4° 5´ W, 20 Jun 1927, *Maire s.n.* (JE, MPU). SPAIN. ALBACETE: Sierra de Taibilla, Las Cabras, 38° 4´ N 2° 24´ W, 17 Jul 1974, *Charpin and Fdz. Casas 10577* (MA); Hellingen van de Muleto (Sierra de Alcaraz), 38° 25´ N 2° 24´ W, 3 Jun 1964, *Stud. Biol. Rheno–Trai. in itinera 64–784* (U); Entre Viano y Riopar. Monte Cerrolloso, 38° 33´ N 2° 28´ W, 28 Jun 1988, *Aparicio, García, F. and Silvestre s.n.* (SEV). ALMERIA: Sierra de Gador. Umbebung von Los Boliches, 36° 56´ N 2° 54´ W, 23 May 1997, *Lewejohann and Müller, J. 97–575* (GOET). GRANADA: Dornajo, Sierra Nevada, 37° 7´ N 3° 26´ W, 25 Jul 1970, *Barrier and Boivin 222* (G); Sierra Nevada, Cerro Trevenque, 37° 4´ N 3° 28´ W, 2 Jul 1980, *Ladero, Socorro and Hurtado s.n.* (MA); Sierra Nevada: Valle de Monachil, occid. vers a Cañadillas, 37° 7´ N 3° 31´ W, 6 Jul 1970, *Elsa and Wängsjö 3890* (LD); Sierra de Baza, Collado de la Fábrica, 37° 27´ N 2° 44´ W, 11 Jul 1984, *Torres, Blanca, G. and Morales, C. s.n.* (GDA); Sierra de Baza, Calar de la Rapa, 37° 20´ N 2° 52´ W, 15 Jul 1985, *Torres, Blanca, G. and Morales, C. s.n.* (GDA). HUESCA: route de Sta Cruz de los Seros à San Juan de la Peña, 42° 31´ N 0° 40´ E, 8 Jun 1983, *Lambinon 79/E/597* (BR). JAEN: Cazorla, lader aoccidental del Caballo de Fuente Acero, 37° 54´ N 2° 48´ W, 9 Jun 1999, *Soriano 2125* (MA); Cazorla: entre la Fuente del Oso y el Parador del Adelantado, 37° 54´ N 2° 57´ W, 24 Jun 1975, *Gonzalez Rebollar, Muñoz Garmendia and Soriano 4568* (MA).

Notes: Stipa dasyvaginata resembles *S. eriocaulis* and *S. pulcherrima* by having the adaxial surface of the basal leaf–blade with ribs scabrous or papillae and furrows minutely pubescent (Martinovský 1970). Such is the case that *S. dasyvaginata* looks like an intermediate species between both ones, from can de distinguished only by the combination of characters. From *S. eriocaulis* can be distinguished by having longer lemmas [(18)18.9–23.2(23.6) *vz.* (14.1)15.5–19.8(21.2) mm long], slightly longer column [(5.2)6.2–8.6(9) *vz.* (3.2)4.9–7.3(8.9) cm long], the abaxial surface of the basal leaf scabrous or minutely scabrous, instead glabrous or minutely scabrous at the base of

S. eriocaulis. It commonly looks like a robuster species of *S. eriocaulis*, morphologicall similar to *S. pulcherimma*. However, from *S. pulcherrima* can be distinguished by having the basal leaf–sheath pubescent, the abaxial surface of the basal leaf–blade scabrous or minutely scabrous and the basal leaf ligule usually pubescent, whereas *S. pulcherrima* exhibit the basal leaf–sheath glabrous or only pubescent near the balde, the abaxial surface of the basal leaf–blade scabrous or distinctly scabrous and the basal leaf ligule usually glabrous or scabrous. However, molecular analyses would be needed to clarify the systematic position and relationship between these three taxa.

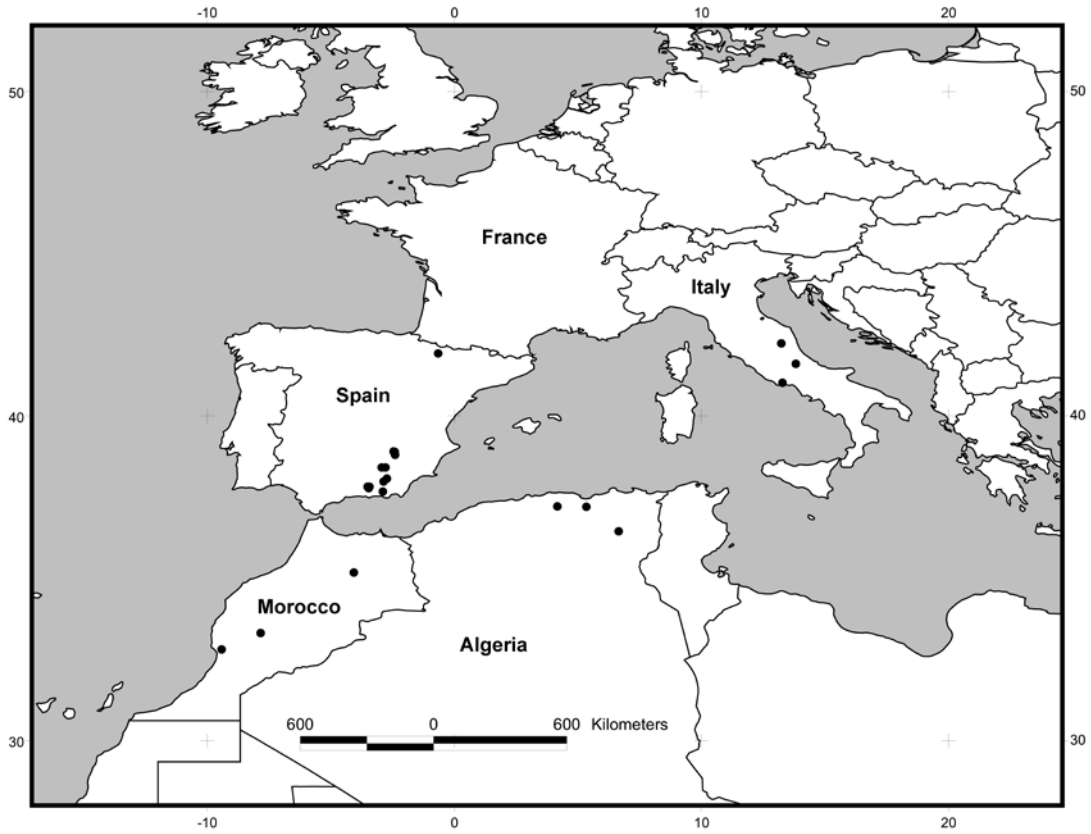

Figure 18. Distribution map: *Stipa dasyvaginata* (●).

9. *Stipa austroitalica Martinovský*

Stipa austroitalica Martinovský, Webbia 20: 723 1965. *Type:* ITALY. Pugliam, M. Gargano a Rodi, Coppe di Ceccatole, 24 May 1913, *Fiori s.n.* (holotype, FI digital image!).

Herbs 25–61 cm high, perenial caespitose; branching intravaginal. Culms 2–3 noded, nodes glabrous, violet or brown; culm internodes pubescent or scabrous, the remainder pubescent, scabrous or sparsely pilose (rarely glabrous). Basal leaves 20–75 cm long, green; leaf–sheath usually minutely pubescent, ciliate (rarely glabrous), cilia (0.18)0.25–0.58(0.77) mm long; leaf–blade 10–64 cm long, (0.46)0.48–0.75(0.83) in diameter, convolute, abaxial surface minutely scabrous at the base which becomes glabrous to the apex, glabrous (rarely completely scabrous), adaxial surface totally pubescent with a mix of short hairs and abundant or sparecely long hairs at the ribs (the

furrows could have small conical papillea instead of the small hairs), hairs (0.26)0.33–0.63(0.85) mm long; ligules (0.56)1.3–2.9(4.3) cm long, rounded, obtuse or truncate, pubescent or scabrous (rarely glabrous), ciliate or ciliolate, cilia (0.02)0.03–0.6(0.8) mm long. Floriferous culm leaves 20–46 cm long; leaf–sheath 14–34 cm long, scabrous with scattered hairs near the leaf–blade and margins, or completely scabrous or papillae, margins usually glabrous; leaf–blade 3–18 cm long, (0.3)0.36–0.69(0.88) mm in diameter, abaxial surface glabrous, scabrous (rarely with sparsely stiff hairs), adaxial face pubescent or minutely pubescent, hairs (0.08)0.13–0.58(0.75) mm long; ligules (1.83)2.38–6.48(7.97) mm long, acute, rounde or obtuse, scabrous or pubescent, margins glabrous or ciliate tip ciliate or ciliolate (rarely glabrous), cilia (0.13)0.19–0.88(0.97) mm long. Panicle 21–51 cm long, contracted, exserted or partially enclosed by the upper leaf–sheath, (2)3–5(6) noded; basal internode (10)15–33(44)) cm long, scabrous, minutely pubescent or pubescent; branches (1.2)1.5–4.2(5.8) cm long, patent or ascending, setaceous, setae (0.15)0.23–0.82(1.1) mm long; basal nodes with 1–2 branches with 1(2) spikelets each. Glumes subequal, lanceolate, long acuminate, glabrous, rarely ciliate on the central nerves, cilia 0.19–0.81 mm long, green with purple stains, margins and tip hyaline, the lower (3.7)4.8–7.4(8.2) cm long and 3–5(7) nerved, the upper (3.3)4.2–6.8(8) cm long and 5–7(9) nerved. Anthecium (5.6)16–21(23) mm long, (0.87)1.1–1.6(1.8) mm wide, fusiform, coriaceous, green, brown or pale brown; lemma (11.8)12.2–16.5(17.5) mm long, near the apex glabrous, with 7 rows of hairs, with the dorsal and subdorsal ones fused and the remainder rows free, or 6 rows of hairs with the dorsal row absent (sometimes the subdorsal row splitted in two, in consequence with 8–9 rows of hairs), the ventral row reaching the top, rarely ending 0.6–7 mm below the top, the dorsal row measuring 1/2–1/4 the lentgh of the lemma or absent, the subdorsal rows longer or slightly shorter than the dorsal row and the lateral rows always longer than the dorsal and subdorsal rows, lemma with patent hairs (0.4)0.49–0.78(0.91) mm long; apex glabrous; callus (3.3)3.6–4.9(5.3) mm long, acute, curved, villous, hairs (1.3)1.7–2.7(3.3) mm long on the ventral face and (0.9)1.1–1.7(2.3) mm long on the dorsal face, scar elliptic, peripheral ring (0.86)0.91–1.2(1.38) mm long, (0.31)0.32–0.43(0.44) mm wide (ratio wide/length= 0.31–0.38(0.39)); palea (11.6)12–15.6(18) mm long, lanceolate, margins and tip hyaline, dorsally 2–nerved, between the two nerves papillae or glabrous, margins glabrous and tip usually ciliate, rarely with a dorsal row of hairs up to 1/4 the length of the palea, green or brown pale; lodicules 3, equal or subequal, with the dorsal ones slightly longer or shorter than the ventral one, acute, lanceolate or linear lanceolate, membranous, glabrous or the dorsal ones ciliate at the apex, dorsal lodicules (2)2.37–3.3(4.1) mm long, ventral lodicule (1.83)2.32–3.32(3.6) mm long. Awn (19.5)22–34(38) cm long, bigeniculate; column (4.7)5.4–8.7(8.9) cm long, base (0.51)0.54–0.76(0.77) mm in diameter, twisted, brown, brown and green (rarely with purple stains), glabrous or somewhat scabrous; geniculation(1.2)1.6–2.5(2.7) cm long, usually scabrous and sometimes with scattered hairs; seta (14.5)16.2–27.3(29.1) cm long, (ratio column length/seta length = (0.23)0.26–0.41(0.43)), flexuous, plumose, hairs in lower part (4.2)4.4–5.5(6) mm long. Anthers (5.2)7–10(11.4) mm long, usually glabrous, yellow or purple. Ovary glabrous, styles two. Caryopsis (8.1)8.8–11.7(12.3) mm long, fusiform; embryo1.6–2.4(2.6) mm long.

9a. *subsp. austroitalica.*

Stipa pennata raza *appendiculata* Celak., Oesterr. Bot. Z. 33: 319. 1883; *Stipa pennata* subsp. *appendiculata* (Celak.) K. Richt., Pl. Eur.: 32. 1890; *Stipa pulcherrima* [unrancked] *appendiculata* (Celak.) Podp., Práce Morav. Přír. Společn. 2: 698. 1926; *Stipa austroitalica* var. *appendiculata* (Celak.) Martinovský, Webbia 20: 724. 1965; *Stipa austroitalica* subsp. *appendiculata* (Celak.) Moraldo, Webbia 40: 254. 1986. *Type*: ITALY. Sicilia. Villabate sul Monte, May 1876, *Lojacono s.n.* (holotype, FI!).
Stipa pennata subsp. *kiemii* Martinovský, Preslia 44: 14. 1972; *Stipa eriocaulis* subsp. *kiemii* (Martinovský) Tzvelev, Zlakii SSSR: 590. 1976; *Stipa oligotricha* subsp. *kiemii* (Martinovský) Moraldo, Webbia 40: 250. 1986. *Type*: ITALY. M. Gargano, apud viam sub "Monte Acuto" sitam et a vico "Monte Sant Angelo", 19 May 1970, *Kiem s.n.* (holotype, PRC digital image!; isotype, M!).
Stipa austroitalica subsp. *theresiae* Martinovský and Moraldo, Preslia 52: 18. 1980. *Type*: ITALY. Cosenza, Fascineto, 2 Jun 1977, *Moraldo and Savino s.n.* (holotype, NAP; isotype, G!).
Stipa oligotricha Moraldo, Webbia 40: 248. 1986. *Type*: ITALY. M. Gargano, Valico del Lupo, 21 May 1978, *Moraldo, Carlevaris and Deromedi s.n.* (holotype, FI digital image!; isotypes, G!, NAP, RO, Moraldo herbaria).
Stipa austroitalica subsp. *frentana* Moraldo and Ricceri in Webbia 58: 104. 2003. *Type*: ITALY. Lentella. 28 May 1994 *Moraldo and Ricceri s.n.* (holotype, FI digital image!; isotypes, G!, K, M!, PR, W!).
Stipa aquilana Moraldo, Annlt. Checkl. Italian Vasc. Fl: 22. 2005; *Stipa martinovskyi* Moraldo, Webbia 37: 25. 1983, nom. illeg. [nom subst.]. *Type*: ITALY. Abruzzo. Arischia (L´Aquila). Gruppo del Gran Sasso d´Italia: Monte S. Franco, 24 Jul aa1981, *Moraldo s.n.* (holotype, FI digital image!; isotype, NAP and Moraldo herbaria).

Herbs 25–61 cm high. Basal leaf–blade 19–75 cm long, (0.46)0.48–0.69(0.78) mm in diameter; ligule (0.5)1.1–2.6(3.3) mm long. Glumes (3.3)4–6.8(7.5) mm long. Anthecium (15.4)16–20.1(22) mm long, (0.9)1–1.4(1.5) mm in diameter, apex with two lobes (0.02)0.08–0.7(2) mm long or absent. Lemma (11.8)12.2–16.5(17.5) mm long, with 7 rows of hairs with the dorsal row slightly longer or shorter than the subdorsal row of hairs, or with 6 rows of hairs with the dorsal row absent, the ventral row of hairs reaching the lemma apex (rarely ending before the top). Awn (19)22–33(37) cm long; column (4.7)5.3–8.5(8.9) cm long, 0.51–0.77 mm in diameter; seta (14.5)16–26(29) cm long, plumose, hairs (4.3)4.5–5.3(5.7) mm long. (Fig. 19 k–p; Fig 7 b_1, b_3).

Chromosome Number: unknown.

Habitat and Distribution: *Stipa austroitalica* subsp. *austroitalica* is a component of the Mediterranean gariga over rocky slopes pastures and open scree, 100–1000 m. Endemic of South Italy and Sicilia. (Fig. 20).

Phenology: Flowering and fruiting from April to June.

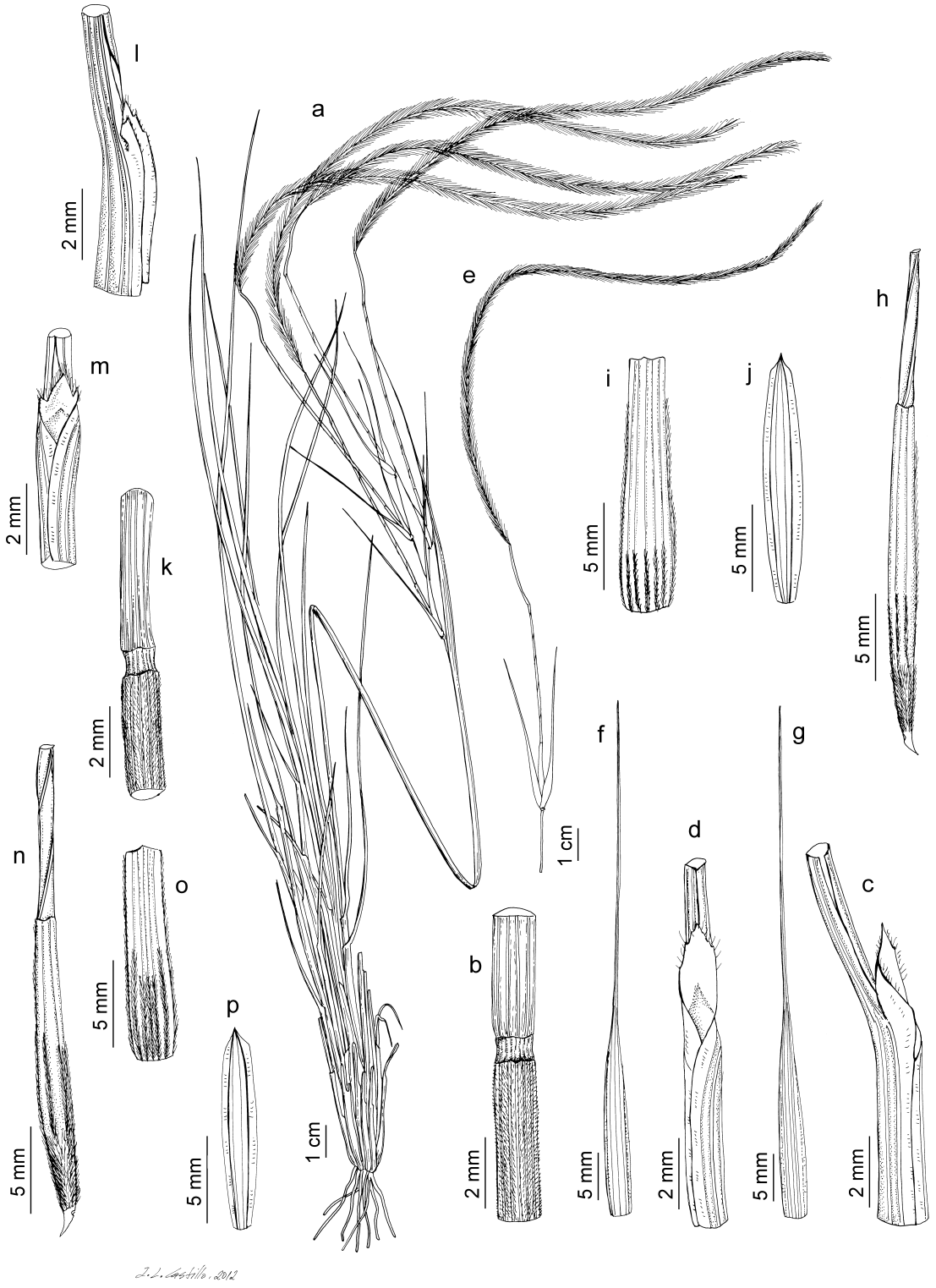

Figure 19. *Stipa austroitalica* subsp. *sicula*. A, habit; B, floriferous culm node; C, ligule, lateral view; D, ligule, frontal view; E, spikelet; F, upper glume; G, lower glume; H, anthecium and column; I, lemma; J, palea. *Stipa austrotialica* subsp. *austroitalica*. K, floriferous culm node; L, ligule, lateral view; M, ligule, frontal view; N, anthecium and column; O, lemma; P, palea. [Based on: A–J, *Herrero et al. 886* (MA); K–P, *Aldobarandi and Baldini 18777* (MA).]

Representative Specimens Examined: ITALY. Abruzzo: Lentella, 42° 0´ N 14° 40´ E, 28 May 1994, *Moraldo and Ricceri s.n.* (W). Basilicata: Prov. Taranto: zwischen Lateraza und Matera (Strabe Nr 7) am Zementwerk, 40° 30´ N 16° 25´ E, 3 Jun 1985, *Hilger 246* (M). Calabria: Morano Calabra (Italie, prov. Cosenza, Calabre), lelonge de la Route Nationale nº 19 au km 190, 39° 50´ N 16° 7´ E, 10 Jun 1997, *Aldobarandi and Baldini 18777* (BR, H); Calabria: Castrovillari, 39° 48´ N 16° 12´ E, 12 Jun 1978, *Moraldo s.n.* (G, M); Cassano, 39° 47´ N 16° 19´ E, 20 May 1977, *Moraldo s.n.* (WU); Frascineto (Calabria), 39° 50´ N 16° 16´ E, 17 May 1978, *Moraldo s.n.* (WU). Puglia: Basilikata: ca. 2–3 km SE von Melfi, C. Montemarano, gegen den Toppo S. Baola, 40° 55´ N 15° 0´ E, 24 May 1977, *Burri and Krendl s.n.* (W); Manfredonia, 41° 38´ N 15° 54´ E, 6 May 1958, *Boom 35599* (L); Dintorni de Carpino, 41° 45´ N 15° 50´ E, 18 May 1893, *Martelli s.n.* (S); Monte Gargano, ca. 3 km nord–östlich Mattinata an der Küstenstrabe nach Vieste, 41° 42´ N 16° 3´ E, 4 May 1968, *Hiepko 179* (B); Ostuni, Marina de Ostuni, in der Nähe der Masseria S. Lucia, zwischen dem Ort Marina di Ostuni und Costa Merlata, 40° 44´ N 17° 35´ E, 19 Apr 2003, *Dunkel 08874–1* (M); Trockenhänge und Marmorbrüche 16 km westlich Manfredonia an der Strabe nach Foggia, 41° 38´ N 15° 47´ E, 20 Apr 1964, *Leins s.n.* (M); Südrand des Montes Gargano südöstlich San Giovanni Rotondo. Weideland mit etwas Gebüsch, 41° 31´ N 15° 44´ E, 25 Apr 1968, *Hiepko 15* (B); Promontorio del Gargano, 41° 50´ N 16° 0´ E, 31 May 1994, *Licht 1747a* (B); Prov. Foggia: Promontorio del Gargano: Monte S. Angelo, 41° 42´ N 15° 58´ E, 23 Apr 1989, *Hörandl and Hadacek 3244* (W). Sicilia: In collibu calcarey maritime Trapani in Sicilia, 38° 1´ N 12° 29´ E, n.d., *Parlatore s.n.* (BR); Sicilia: Palermo , In aridis cálcareos montosis a Montagna Grande presso Villabate, 38° 4´ N 13° 26´ E, May 1879, *Lojacano s.n.* (G); Madonie: W. slopes of Mt. Quacella, W. of Mt. S. Salvatore, 37° 51´ N 14° 1´ E, 8 Jun 1983, *Greuter and Matthäs 19908* (B); Villafrate, 37° 54´ N 13° 29´ E, n.d., *Lojacano s.n.* (W).

9b. ***Stipa austroitalica*** **subsp. *sicula*** **(**Moraldo, Caputo, La Valva and Ricciardi) R. Gonzalo

Basion.: *Stipa sicula* Moraldo, Caputo, La Valva and Ricciardi, Delpinoa 23–24: 139. 1981–1982. *Type*: ITALY. Sicilia, Madonie, Monte Quacella, pascoli assosi aridi, esp. WSW, c.a 1300m, 8 Jun 1983, *Caputo and Ricciardi s.n.* (Holotype, NAP; isotype, NAP, FI digital image, PAL).
Stipa siciliensis Martinovský, Webbia 20:728 (1965), nom. inval. *Type*: ITALY. Palermo, May 1876, *Lojacano s.n.* (holotype, W!).

Herbs 30–60 cm high. Basal leaf–blade 14–40 cm long, 0.52–0.83 mm in diameter; ligule 1.8–3.6(4.3) mm long. Glumes (5.3)5.4–8(8.2) mm long. Anthecium 17.6–22.2(22.8) mm long, 1.16–1.5(1.6) mm in diameter, apex with hairy lobes 0.27–1.14 mm long or absent. Lemma (13.7)13.8–17(17.5), with 7 rows of hairs with the dorsal row slightly shorter or slightly longer than the subdorsal rows of hairs (rarely with 6 rows of hairs with the dorsal row absent), the subdorsal row of hairs sometimes bifid, the ventral row of hairs ending 1.7–7.3 mm before the lemma apex. Awn (27.4)28–37(38) cm long; column 6–8.7 cm long, 0.62–0.74 mm in diameter; seta 21–29 cm long, plumose, hairs (4.3)4.7–5.8(6) mm long. (Fig. 19 a–j; Fig 7 b_2).

Chromosome Number: unknown.

Habitat and Distribution: *Stipa austroitlaica* subsp. *sicula* is endemic of the Madonie Mountain of Sicilia (Italy). 1200–1600 m. (Fig. 20).

Phenology: Flowering and fruiting from June to July.

Representative Specimens Examined: ITALY. Sicilia: Sperlinga neighberhoods, 37° 45´ N 14° 21´ E, 8 May 1990, *Raimondo et al. 1669* (PAL); Monte Grifone, 38° 4´ N 13° 23´ E, 1860, *Citarda s.n.* (JE); Madonie, presso Piano Zucchi, 37° 54´ N 13° 59´ E, 6 Jun 2003, *Cristofolini s.n.* (BOLO); Madonie. M. Quacella, 37° 51´ N 14° 1´ E, 19 Jun 1983, *Moraldo s.n.* (FI), Prov. Palermo: Madonie, Mont Quacella (Halfway between Polizzi Generosa and Piano Battáglia), 37° 49´ N 14° 0´ E, 8 Jun 1983, *Uotila 32428* (H); Palermo: Polizzi Generosa, Parco della Madonie, Vallone Madonna degli Angeli, 37° 51´ N 14° 1´ E, 2 Jun 2000, *Herrero et al. 886* (MA); Monts Madonie, Monte Quacella (au N de Polizii Generosa), 37° 51´ N 14° 1´ E, 8 Jun 1983, *Lambinon and Rousselle 83/Si/115* (BR).

Notes: *Stipa austrotialica* closely resembles *S. atlantica*, having both the adaxial surface of the basal leaf densely hairy or with sparsely soft hairs, having the same spikelets morphology and occurring in similar habitat. However, *S. austroitalica* is distinguishable by its usually glabrous or almost glabrous abaxial surface of the basal leaf–blade and by having the furrows of the adaxial surface usually covered by short hairs. Whereas *S. atlantica* exhibit the abaxial surface distinctly scabrous and the furrows of the adaxial surface usually covered by short prickles or papillae (Martinovský 1966, 1982). Likewise, *S. austroitalica* is restricted to south Italia and Sicilia, whereas *S. atlantica* is found in Spain, South France and the Atlas Mountains of Morocco and Algeria.

Stipa austroitalica could have the adaxial surface of the basal leaf, densely hairy or with scattered hairs. Scattered hairs forms have been described as *S. oligotricha* (Moraldo 1986). However many transitional forms joint from densely pubescent to scattered pilose, which also happens in other species of the subsection such as the closely related taxa *S. atlantica*. Moraldo (1986) also pointed out the scabrous abaxial surface of the basal–leaf, scabrous column and shorter seta hairs (3–4 mm long), against the glabrous abaxial surface of the basal–leaf, glabrous column and longer hairs (4–5 mm long) of *S. austroitalica*. However all this characters have been found in specimens described as *S. austroitalica*. Likewise, the distribution of *S. oligotricha* overlaps with *S. austroitalica*. All this data made us reluctant to accept *S. oligotricha*, which we have subsumed under *S. autroitalica*.

Stipa austrotialica usually has the ventral row of the lemma reaching the top. However some specimens, endemic of north Sicilia, have the ventral row ending before the lemma apex, which have been called *S. sicula* (Moraldo et al. 1981–1982; Martinovský 1966). This quality has related this species with *S. pennata*. However, the leaf and lemma ornamentation, clearly relates this species with *S. austrotialica*. Both taxa are morphologically identical, excluding the length of the ventral row. However, specimens with the ventral row ending before the lemma apex are found at SE Calabria and have been called *S. austrotialica* subsp. *theresiae*. However, we have found that these specimens could exhibit indistinctly lemmas with the ventral row reaching the top or not in the same plant. While, specimens from Sicilia, always has the ventral row ending before the lemma apex and the remainder features more or less constant. Therefore, as being restricted to Sicilia, its stable characters and similarity with *S. austrotialica*, we have combined the taxa as subspecies, *S. austrotialica* subsp. *sicula*.

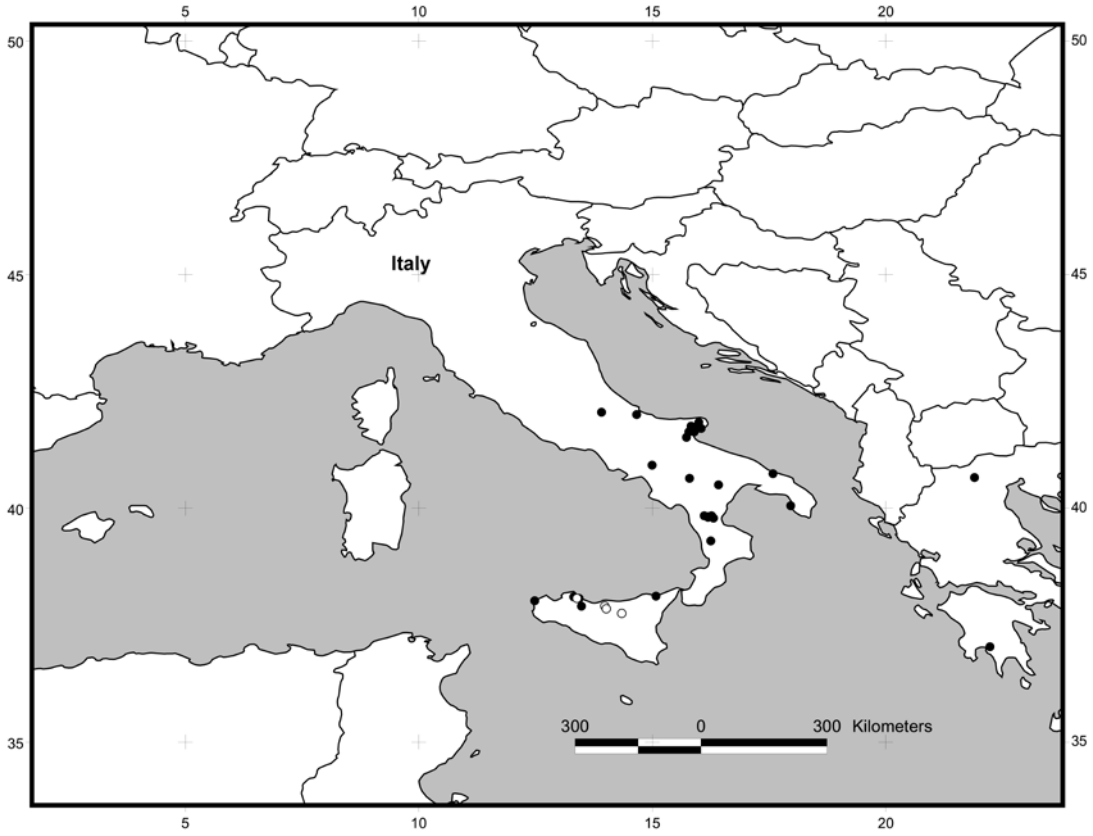

Figure 20. Distribution map: *Stipa austroitalica* subsp. *austroitalica* (●); *S. austroitalica* subsp. *sicula* (○).

10. *Stipa endotricha* Martinovský

Stipa endotricha Martinovský, Preslia 44: 12. 1972. *Type*: GREECE. Peloponnesus: Achaia. In montis Chelmos (Aroania), 19 May 1926 *Bornmüller 1580* (holotype, W).
Stipa achaica Martinovsky, nom. inval. pro syn.

Herbs 28–76 cm high, perennial caespitose; branching intravaginal. Culms 2–3 noded, nodes glabrous, violet or brown; culm internodes scabrous or pubescent, the remainder glabrous, scabrous or pubescent. Basal leaves 27–51 cm long, green; leaf–sheath minutely pubescent or glabrous, ciliate or glabrous, cilia 0.2–0.52 mm long; leaf–blade 17–43 cm long, 0.5–0.7 mm in diameter, convolute, abaxial surface glabrous or minutely scabrous at the base and the remainder glabrous, adaxial surface scabrous with sparsely hairs, prickles 0.01–0.4 and hairs 0.17–0.47 mm long; ligules 1–3.7 cm long, usually rounded or obtuse, usually scabrous, ciliolate, cilia 0.03–0.43 mm long. Floriferous culm leaves 23–38 cm long; leaf–sheath 16–29 cm long, totally scabrous or scabrous near the the leaf–blade and the margin and the remainder glabrous, margins usually glabrous; leaf–blade 7–13 cm long, 0.37–0.66 mm in diameter, abaxial surface usually glabrous, adaxial face scabrous, scabrous with sparsely stiff hairs or pilose, prickles 0.01–0.04 and hairs 0.1–0.21 mm long; ligules (3.3)3.7–8.1(9.3) mm long, acute or rounded, usually scabrous or pubescent, margin glabrous or ciliate, tip usually

ciliate or ciliolate, cilia 0.05–0.6(0.62) mm long. Panicle 20–46 cm long, contracted, exserted or partially enclosed by the upper leaf–sheath, 3–5 noded; basal internode 10–46 cm long, pubescent, scabrous or glabrous; branches 1–3.8 cm long, patent or ascending, setaceous, minutely setaceous or glabrous, setae 0.4–1 mm long; basal nodes with 1–2 branches with 1(2) spikelets each. Glumes subequal, lanceolate, long acuminate, glabrous, sometimes with the central nerve ciliate, cilia 0.1–0.6 mm long, green with the margins and tip hyaline (sometimes with purple stains), the lower (5.2)5.3–7.8(8) cm long and 3–6 nerved, the upper (4.7)4.8–7.5 cm long and 5–8 nerved. Anthecium 17.2–21.3(21.4) mm long, 1.1–1.6 mm wide, fusiform, coriaceous, green, brown or pale brown; lemma (13.6)13.7–16.8 mm long, near the apex glabrous, with 7 rows of haris, with the dorsal and subdorsal ones fused and the reamainder rows free (rarely with 6 rows of hairs with the dorsal row absent), the ventral row reaching the top, the dorsal row measuring more than 1/3 the length of the lemma, the subdorsal rows longer than the dorsal row and the lateral rows always longer than the dorsal and subdorsal row, lemma with patent hairs (0.4)0.5–1.4(1.9) mm long; lemma apex glabrous; callus (3.4)3.5–4.8(4.9) mm long, acute, curved, villous with hairs (1.3)1.5–2.9(3) mm long on the ventral face and (0.8)0.9–1.5 mm long on the dorsal face, scar elliptic, peripheral ring (1.04)1.05–1.37(1.43 mm long, 0.35–0.45(0.47) mm wide (ratio wide/length= 0.31–0.34); palea 13.2–16.6 mm long, lanceolate, margins and tip hyaline, dorsally 2–nerved, between the two nerves papillae or glabrous, margins glabrous and tip usually ciliate, green or brown pale; lodicules 3, equal or subequal, with the dorsal ones slightly longer or shorter than the ventral one, acute, lanceolate or linear lanceolate, membranous, glabrous or the dorsal lodicules ciliate at the apex, dorsal lodicules 3–4.4 mm long, ventral lodicule 2.74.4 mm long. Awn (17.1)18.2–28.2 cm long, bigeniculate; column (4.7)4.8–8.8(9.2) cm long, base (0.5)0.51–0.72 mm in diameter, twisted, brown or brown and green, usually glabrous; geniculation (1.5)1.6–2.5 cm long, glabrous, minutely scabrous (rarely sparsely pilose); seta (12.4)13.4–20.5 cm long, (ratio column length/seta length = (0.28)0.3–0.47(0.49)), flexuous, plumose, hairs in lower part 4–5.9(6.1) mm long. Anthers 7.5–10.8 mm long, glabrous yellow or purple. Ovary glabrous, styles two. Caryopsis 10.3–13.2 mm long, fusiform; embryo 2.3–2.4 mm long. (Fig. 9 a–l; Fig. 10 a)

Chromosome Number: Unknown.

Habitat and Distribution: Inhabits rocky slopes of low mountains belts to the mountain peak, 500–2000 m. Endemic from Greece. (Fig. 21)

Phenology: Flowering and fruiting from May to July.

Representative Specimens Examined: GREECE. Anatolikí Makedonía kai Thráki: Xanthis. Nestoe river gorge between Kromniko and Toxotes, 41° 6´ N 24° 44´ E, 21 May 1997, *Strid et al. 42473* (C). Attica: In m. Parnethe pr. Dekeleiam (hod. Tatoi), 38° 10´ N 23° 47´ E, May 1828, *Holzmann s.n.* (W). Epirus: Ioanninon. Mt. Timfi, 4 km E–ENE of Papigon, 0,5–1,5 km S of the EOS Kaafygion by Drakolimni. NE part of the peak Astraka, 39° 58´ N 20° 48´ E, 26–28 Aug 1980, *Franzén and Akeroys 170* (LD); Pindus Gebirge: Mitsikeli Oros: E Joannina, oberhalb Mazja, 39° 45´ N 20° 50´ E, 12 Jul 1978, *Krendl, E. and Krendl, F. s.n.* (W). Macedonia Central: NomosImathia: Mt. Vermion, 1 Km W of Naousa. Betweem Mavri Pétra and Tsanaktsi, 40° 37´ N 22° 4´ E, 17–21 Jul 1979, *Lars–Åke Gustavsson and Franzén 8413* (LD). Macedonia Occidental: Florinis/Kastorias: 5 km ESE of the village of Kristallopigi place called Papadochoria, 40° 38´ N 21° 5´ E, 19 Jul 1985, *Strid et al. 24719* (C). Occidental Greece: Nomos Beotia: Helikon Oros, Paliovouna, 2–3 km SW of Koúkoura, 37° 40´ N 21°

32´ E, 6–9 Jul 1979, *Lars–Åke Gustavsson and Franzén 8348* (LD); Levkados. Isl. Levkas. Ep. Levkados. Mt. Stavrota. Near the OTE Station, 38° 43´ N 20° 38´ E, 21 May 1993, *Strid et al. 35541* (C); Island of Levkas: Placed called Strongilo, E above the village of Chhortata, 38° 43´ N 20° 36´ E, 17 May 1985, *Strid 24540* (C); Achaia, Kalavrita, mts Chelmos, mt Avgho, 38° 1´ N 22° 10´ E, 21 Jun 2007, *Aedo et al. 14212* (MA). Peloponnesse: Achai, in montis Chelmos (Aroania), 37° 53´ N 22° 0´ E, 19 May 1926, *Bornmüller 1580* (W); Arkadias. Ep. Kinourias. Porstweg nach Sitena und Prof. Ilias (MegaliTourla) ca. 3 km oberhalb der Abzweigung von der Strabe zwischen Aj. Petros und Astros, 37° 20´ N 22° 36´ E, 8 Jun 1995, *Bergmeier 95–290* (C); Arkadias./Lakonias Ep. Kinour./Lakedem. Mt. Parnonas. hochebene unterhalb des M. Tourla (Prof. Ilias), 37° 17´ N 22° 37´ E, 12 Jun 1995, *Bergmeier 95–417* (C); Lakonias. Ep. Lakedomonos. Mt. Taigetos. 2 km from EOS katafigion along road descending to Paleopanagia., 36° 57´ N 22° 23´ E, 20 May 1995, *Strid et al. 39428b* (C); Prov. Arkadhia, distr. Mandinia: in regione superiore verticis Tzelati montis Menalo, 37° 31´ N 22° 22´ E, 13 Jul 1971, *Greuter 9384* (G); Peloponessus, prin cacumini m. Malevo, 37° 10´ N 22° 15´ E, 4 Jul 1886, *Heldreich s.n.* (G). Thessalia: Nom. Larisis, Mt Olympus: C. 1 km SE the village of Kokkinoplos, 40° 5´ N 22° 15´ E, 20 Jun 1970, *Strid 68* (C).

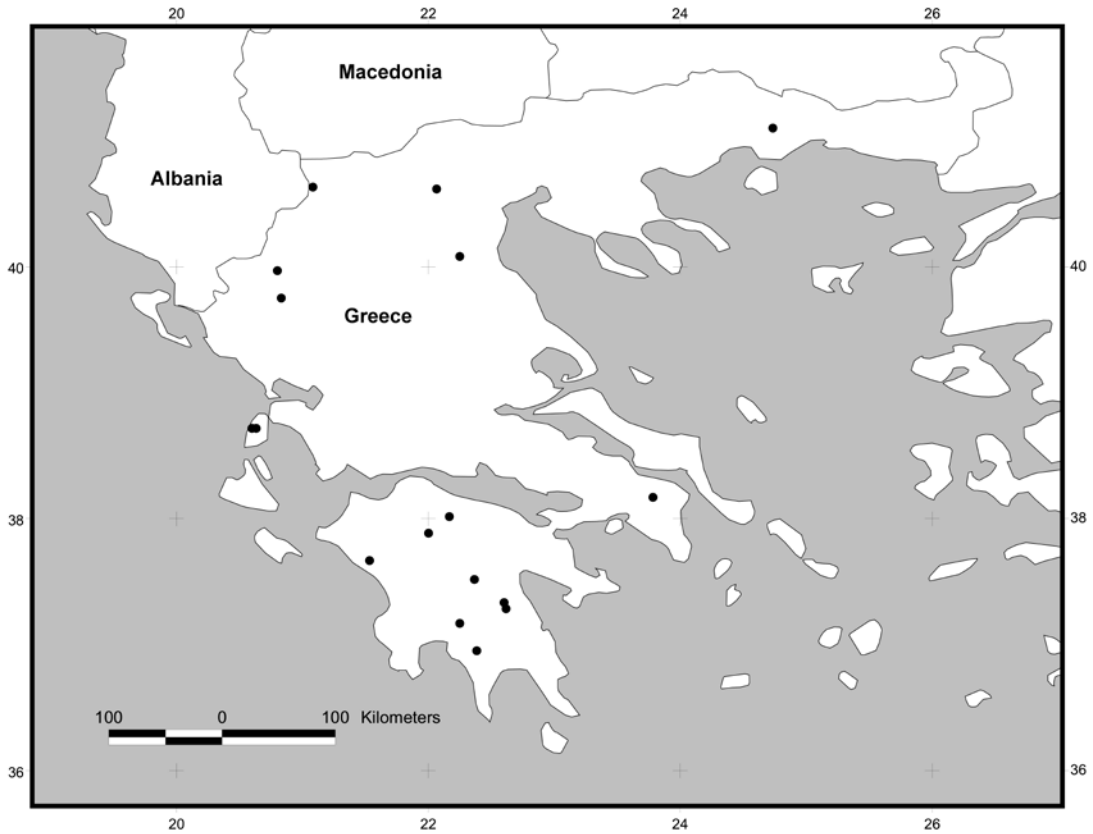

Figure 21. Distribution map: *Stipa endotricha* (●).

Notes: Stipa endotricha is closely related to *S. epilosa*, from which differs in having scattered hairs on the adaxial surface of the basal leaves. This feature and its well defined distribution, restricted to Greece, is why we have retained it as a species.

DOUBTFUL AND EXCLUDED NAMES

Stipa adoxa Klokov and Osȳchnyuk, Novosti Sist. Vyssh. Nizsh. Rast. 1975: 28. 1976. *Type:* UKRAINE. Donetzica, reservatum natural Chomutovskaja, loco Blyzhni Terny, 1 Jun 1973, *Osȳchnyuk s.n.* (holotype, KW).

Stipa alexandri Woronow ex Grossh., Fl. Kavk. 1: 152. 1939, nom inval. pro. syn.
Stipa crassiculmis subsp. *macedonico–anatolica* Martinovský, Bot. Közlem. 54: 50 1967, nom illeg . *Type:* not designated.
Stipa gallica var. *hirsuta* Podp., Verh. K.K. Zool.–Bot. Ges. Wien 52: 678. 1902. *Type:* Unknown.
Stipa grafiana var. *hirsuta* Velenovsky ex Celakovsky, Sitzungsber. Königl. Böhm. Ges. Wiss. Prag 1885: 18. 1885; *Stipa pennata* [II] *hirsuta* (Velenovsky ex Celakovsky) Asch. and Graebn., Syn. Mitteleur. Fl. 2: 107. 1899; *Stipa pulcherrima* var. *hirsuta* (Velenovsky ex Celakovsky) Handel–Mazzetti ex Wettstein, Fl. Exsicc. Austro–Hung. 10: 126. 1913. *Type:* Unknown.
Stipa grafiana f. *leiantha* Borbás, Mat. Természettud. Értes. 15(9): 310 1878; *Stipa grafiana* f. *leiantha* (Borbás) Soó,Acta Bot. Acad. Sci. Hung. 17: 123. 1972. *Type:* Unknown.
Stipa grafiana f. *pubiflora* Borbás, Mat. Természettud. Értes. 15(9): 310 1878; *Stipa grafiana* f. *pubiflora* (Borbás) Soó, Acta Bot. Acad. Sci. Hung. 17: 123. 1972. *Type:* Unknown.
Stipa isoldae H. Scholz, Wilddenowia 19: 127. 1989. *Type:* GREECE. Nomos und Eparchia Grevena, Vourinos Massiv, östl. Exharos, 16 Aug 1983, *Ketelhut and Wolf, H.–J. s.n.* (holotype, B, digital image!). By the description of the specimens, it might be a synonymy of *S. endotricha*. The image has low resolution and no finall conclusion can be made until the specimens is examined.
Stipa issaevi Musajev and Sadykhov, Dokl. Akad. Nauk Azerbaidzhansk. S.S.R. 34(1): 49–50. 1978. *Type:* Unknown.
Stipa karjaginii Musajev and Saychov, Novosti Sist. Vyssh. Rast. 14: 5. 1977. *Type:* AZERBAIJAN. Respublica autonoma Nachiczevan, in viciniis pag. Lizbirt, in declivitate herbido sicco, 24 May 1975, Sadychov s.n. (holotype, BAK; isotype, LE). It looks like a robust plant of *S. epilosa*. However, we have only study the isotype, which only has the panicle and floriferous culm leaves. No final conclusion can be made until a complete specimen is studied.
Stipa montícola Scholz, Willdenowia 23: 117 (1993). *Type:* GREECE. Nomos Imathia, Vermion–Massiv, 1–1.8 km N Ano Seli (Ima 64 f), 7 Jun 1990, Willing 9603a (holotype, B), 9603b (isotype B). The application of this name is in doubt until the type can be examined. By the description of the specimens, it might be a synonymy of *S. endotricha*.
Stipa pennata [unranked] *gallica* Stev., Bull. Soc. Imp. Naturalistes Moscou 30: 115 o 116 (1857), nom. inval.; *Stipa gallica* Steven ex Celak., Oesterr. Bot. Z. 33: 315. 1883; *Stipa pennata* subvar. *gallica* (Steven ex Celak.) Hayek, Prodr. Fl. Penins. Balcan. 3: 349. 1932; *Stipa pennata* subsp. *gallica* (Steven ex Celak.) Jirasek in Dostál, Květena ČSR: 1929. 1950; *Stipa pennata* [B] *gallica* (Steven ex Celak.) Asch. and Graebn., Syn. Mitteleur. Fl. 2: 108. 1899; *Stipa pulcherrima* var. *gallica* (Steven ex Celak.) Watzl, Oesterr. Bot. Z. 58: 106. 1908. *Type:* Unknown.
Stipa pennata var. *mediterranea* Trin. and Rupr., Sp. Gram. Stipac. 1: 82. 1842; Stipa pennata [*B*] mediterranea (Trin. and Rupr.) Asch. and Graebner, Syn. Mitteleur. Fl. 2: 106; Stipa pennata subsp. mediterranea (Trin. and Rupr.) Hayek, Prodr. Fl. Penins.

Balcan. 3: 349. 1932 ["Stupa"]. *Type:* (lecotype, designated by Vázquez and Devesa, 1996). The type was designated by Vazquez and Devesa (1996), and the specimens was included under the synonymy of *S. iberica*. However, we were not able to see the type in LE, and until the material is examined no decision can be taken.

Stipa pulcherrima f. *subtilis* Roshev. in Kom. (ed.), Fl. URSS 2: 741. 1934, nom inval, pro syn.

Stipa pulcherrima var. *pubifrons* Podp. in Práce Morav. Přír. Společn. 2: 699. 1926; *Stipa eriocaulis* f. *pubifrons* (Podp.) Soó in Acta Bot. Acad. Sci. Hung. 17: 123. 1972. *Type:* Unknown.

Stipa pulcherrima K.Koch subsp. epilosa var. *alagezica* Tzvelev in Takhtajan Konspekt Fl. Kavkaza 2: 353. 2006. *Type:* ARMENIA. Mons Alagez, in angust. Ergja 20 Aug 1932 E et N. Busch (holotype LE).

Stipa schisensis Roshev. ex Grossh., Fl. Kavk. 1: 65. 1928, nom inval. pro. syn.

Stipa × *subgrafiana* Podpera in Práce Kvetena Moravy VI 2: 424 (1926); Morav. Přír. Společn. 2(10): 694. 1926. *Type:* not designated

Stipa vulgaris Gueldenst., Reis. Russland 2: 39. 1791, nom. nud.

Stipa zaljeskyii Grossh., Fl. Kavk. 1: 67. 1928, nom illeg, var. orth.

ACKNOWLEDGEMENTS

The authors wish to thank the staff of the cited herbaria for their support on our visit and/or loan of material. We are also indebted to Dr. Félix Muñoz Garmendia for his authorized advices in nomenclature, to Dr. Elena Glazcova for the Russian translation, and to Joel Calvo for the digital images provided. This work was supported by the *Flora iberica* project CGL2008–02982–C03–01/CLI, Ministerio de Educación y Ciencia, Spain. Our visit to the W herbarium was funded by the FPVI European–funded Integrated Infrastructure Initiative grant SYNTHESYS.

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DISCUSIÓN

Stipa sección *Stipa* y grupos afines se han considerado tradicionalmente como un grupo taxonómicamente complejo. Los altos niveles de poliploidía, la eficacia de sus mecanismos de dispersión y la gran variabilidad de hábitat que ocupan probablemente han contribuido a dificultar una adecuada delimitación de los taxones. Por otro lado los estudios previos eran esencialmente regionales, lo que ha implicado la descripción de un gran número de especies de ámbito local. Freitag (1985), Szholz (1985) y Tzvelev (1974, 1976), ya plantearon la necesidad de reducir el número de especies aceptadas. Los análisis exploratorios y multivariantes de las variables estadísticas que obtuvimos a partir de los caracteres morfológicos, y el estudio detallado de los caracteres cualitativos, ha implicado una reducción considerable en el número de especies, y una delimitación más consistente de dichos taxones.

Durante el estudio de la sect. *Smirnovia* se observó que la mayoría de los caracteres empleados para diferenciar las especies del complejo *S. lingua*, no permitían diferenciar claramente las 4 especies. Tzvelev (1976) ya observó la similitud de *S. lipskyi* con *S. ling*ua, cuya única gran diferencia es la columna pelosa. Nuestros datos indican que las diferencias entre *S. magnifica* y *S. lingua* son escasas, pues la mayoría de los caracteres tradicionalmente empleados tienen valores que solapan parcialmente. Los tres taxones comparten caracteres únicos dentro de la sección (callo con la base ensanchada y arista larga con una columna corta y una seta larga y recta). Las pequeñas diferencias morfológicas apreciadas se correlacionan con diferentes áreas geográficas lo que apoya la subordinación de *S. lipskyi* y *S. magnifica* como subespecies de *S. lingua*. Por otra parte ninguna diferencia morfológica se ha observado entre *S. ovzinnikovii* y *S. lingua*.

En la sección *Smirnovia* el estudio minucioso del material de herbario nos ha permitido proponer una nueva clasificación más consistente en la delimitación de los taxones. La escasez de especimenes en algunas de las especies nos ha obligado emplear análisis no paramétricos (MODECLUS) cuyos resultados han sido muy semejantes al análisis de clúster (UPGMA). No obstante los análisis llevados a cabo sin caracteres cualitativos, tiene muy poca resolución, lo que indica la importancia de utilizar conjuntamente caracteres cuantitativos y cualitativos para clasificar los diferentes taxones. Los resultados muestran una sólida diferenciación entre las diferentes especies. Hay que destacar que en las especies de amplia distribución la diferenciación infraespecífica es más compleja especialmente en las áreas de contacto. Tal es el caso de *S. tianschanica* y *S. caucasica*. *Stipa tianschanica* subsp. *tianschanica* y subsp. *gobica* son morfológicamente muy semejantes. La similitud de sus estructuras vegetativas y florales justifica el rango subespecífico para esta última, que previamente había sido tratada como especie. *Stipa klemenzii* había sido anteriormente considerada

como variedad de *S. tianschanica*. Durante este estudio se han detectado caracteres cualitativos sólidos para considerar el rango específico como el más adecuado para *S. klemenzii*, entre los que se puede destacar por su importancia la arista falcada en lugar de recta, y la presencia de líneas subdorsales y laterales fusionadas.

La especie más compleja y que representa más del 70% del total del material estudiado es *S. caucasica*. Su gran amplitud altitudinal y ecológica, se ve reflejado en una elevada variabilidad morfológica que ha conducido a la descripción de numerosos taxones específicos e infraespecíficos. Los datos obtenidos apoyan el reconocimiento de dos subespecies relativamente bien diferenciadas de la típica: subsp. *glareosa*, caracterizada por su menor tamaño y por sus hojas basales con la cara abaxial escábrida; subsp. *drobovii* que se diferencia fácilmente por su callo más corto y con pelos falcados en la cara dorsal (tales caracteres no habían sido indicados previamente).

Stipa gaubae Bor fue inicialmente incluida bajo la serie *Brevigeniculatae*, y caracterizada por su arista unigeniculada. Posteriormente Freitag (1985) basándose en la sus 3 estilos y sus largas lígulas, transfirió esta especie a la sección *Barbatae* A. Junge. Se ha podido constatar que *S. gaubae* presenta una posición intermedia entre ambas secciones lo que apoya el reconocimiento de una sección monotípica: sect. *Subsmirnovia* Tzvelev.

La sección *Stipa* es el grupo con el mayor número de taxones descritos. En general se trata de taxones que se apoyan en caracteres muy variables en *Stipa*. El estudio de abundante material de toda el área geográfica de la sección, ha puesto de manifiesto que el tamaño de las plantas y de sus espiguillas es muy variable, al igual que el indumento de las hojas. El grado de diferenciación de la espiguilla es muy escaso, y para mayor dificultad, caracteres similares aparecen de forma independiente en diferentes áreas, probablemente por procesos de convergencia adaptativa. Dentro de la sección *Stipa*, se han descrito muchos grupos infragénericos, que se basan principalmente en caracteres de las hojas. Se ha comprobado que los caracteres foliares son muy variables y que sería más operativo reducir el número de grupos y apoyarlos en caracteres más sólidos.

Los análisis morfológicos muestran una clara distinción de *S. tirsa*, cuya morfología del lema recuerda a una *S. pennata*, pero los caracteres de las hojas basales son únicos, de ahí su separación en una subsección independiente, subsect. *Tirsae*. La subsección *Stipa*, ha sido redefinida, incluyendo también a especies que presenta las líneas del lema libres hasta la base. *Stipa turkestanica* recuerda a forma más delicadas de *S. pennata*. *Stipa macroglossa* se venía aceptando como especie autónoma, pero su gran similitud con *S. turkestanica*, de la que se distingue por su mayor tamaño y por su área geográfica, aconseja que sea tratada como subespecie.

La especie más polimórfica y con más amplia área de distribución es *S. pennata*. En su seno se han podido reconocer dos subespecies. La subsp. *sabulosa*, se distingue de la típica por el lema y el callo más largo cuya cicatriz es más larga y fina. *Stipa kirghisorum* presenta algunos caracteres intermedios entre *S. pennata* y *S. turkestanica*.

*Stipa kirghisorum s*e mantiene por el momento como especie autónoma hasta que futuros estudios puedan aclarar mejor su estatus.

En la subsección *Pulcherrimae* el grado de diferenciación de las especies es muy escaso. La similitud en la morfología de las espiguillas es casi total, y son los caracteres vegetativos los que mejor permiten distinguir las especies. La gran amplitud ecológica y geográfica de la mayoría de sus especies, ha contribuido a que se describan muchos nuevos taxones basados en pequeñas variaciones locales. El estudio de una gran cantidad de material, que abarca toda el área de dispersión de las especies, ha permitido observar que hay muchas formas de transición. Como consecuencia se ha elaborado una propuesta taxonómica más congruente con los datos morfológicos y geográficos. Así se propone una nueva clasificación, donde el número de taxones ha quedado drásticamente reducido de más de 50 taxones a 15 taxones: 10 especies y 5 subespecies.

CONCLUSIONES

Se ha realizado la revisión taxonómica un grupo de especies del género *Stipa* L. caracterizado por la arista unigeniculada con la seta plumosa o bien la arista bigeniculada, con la seta plumosa y con pelos mayores de 3,5 mm de longitud. Para ello se ha estudiado más de 4000 pliegos de herbarios, de los más de 70 taxones que se reconocían hasta ese momento. En el tratamiento taxonómico se propone una nueva clasificación, en la que se reconocen un total de 3 secciones y 3 subsecciones con un total de 28 especies y 13 subespecies. Este tratamiento es el primero que aborda de forma detallada y completa este grupo de plantas, difiriendo de las propuestas anteriores principalmente en el número de taxones reconocidos y en su rango taxonómico.

1. Tras el estudio de la sección *Smirnovia* Tzvelev, consideramos que *S. ovzinnikovii* deber ser reducida a la sinonimia de *S. lingua* subsp. *lingua*. Del mismo modo, estimamos que *S. lipskyi* y *S. magnifica* han de ser consideradas como subespecies de *S. lingua:* subsp. *lipskyi* (Roshev.) R. Gonzalo y subsp. *magnifica* (A. Junge) R. Gonzalo.

2. Se estudiaron los caracteres cuantitativos y cualitativos de la secciones *Smirnovia* y *Subsmirnovia* mediante análisis no paramétricos (MODECLUS) y análisis paramétricos (UPGMA, CDA y DA). La diferencia de los resultados obtenidos entre algunos análisis, pone en evidencia la importancia de utilizar conjuntamente los caracteres cuantitativos y cualitativos. Se concluye que los caracteres de mayor valor diagnósticos son la longitud e indumento del lema, y la longitud, forma e indumento de la arista. Igualmente se descubren nuevos caracteres de gran valor taxonómico, destacando la presencia de pelos falcados en el callo de *S. caucasica* subsp. *drobovii,* la fusión de las líneas laterales y subdorsales del lema en *S. klemenzii,* la longitud de los cilios de las lígulas de las hojas basales. Con los nuevos datos morfológicos aportados se ha propuesto una nueva clave dicotómica con un total de 14 especies reconocidas en dichas secciones.

3. Se caracterizan las secciones *Smirnovia* Tzvelev y *Subsmirnovia* Tzvelev por su arista unigeniculada o subgeniculada y con la seta plumosa. Se reconocen en su seno un total de 14 especies de las que 13 (más 5 subespecies) pertenecerían a la sección *Smirnovia*.

Para *S. caucasica,* una de las especies más problemáticas, se reconoce un total de 3 subespecies (*caucasica*, *glareosa* y *drobovii*). *Stipa tzvelevii* y *S. barchanica* recientemente descritas se incluyen en la sinonimia de *S. caucasica* subsp. *caucasica*. En función de los resultados obtenidos, se considera que el rango más apropiado para *S. gobica* es el de subespecie.

Cinco especies presentan la arista indistintamente uni o bigeniculada: *S. alaica, S. tallasica, S. kopetdaghensis*, *S. gegarkuni* y *S. okmirii*. El resto de los caracteres nos hace incluirlas bajo la sección *Smirnovia*. Estas especies se consideran de origen híbrido entre individuos de las secciones *Smirnovia* y *Stipa*, lo que pone en evidencia la necesidad de futuros estudios que puedan aportar información sobre las relaciones de parentesco de estas especies.

Finalmente, las peculiaridades taxonómicas de *S. gaubae*, nos hacen considerar a esta especie en una sección independiente, sección *Subsmirnovia*, claramente relacionada con la sección *Smirnovia*.

4. Dentro de la sect. *Stipa* reconocemos una nueva subsección monotípica para ubicar *S. tirsa:* subsect. *Tirsae* (Martinovský) R. Gonzalo. Para la subsección tipo se reconoce un total de 3 especies y 3 subespecies.

Stipa pennata es la especie más polimórfica de la sección. Se caracteriza la subsp. *sabulosa*, que se separa de la subespecie típica por el lema y el callo más largo cuya cicatriz es más larga y fina.

Se considera que el rango más apropiado para *S. trichoides* sea el de subespecie: *S. turkestanica* subsp. *trichoides* como propone Tzvelev en 1974.

Se ha observado que *S. macroglossa* que hasta la actualidad había sido aceptada como una especie independiente, es muy similar a *S. turkestanica*. Por ello proponemos su combinación como subespecie: *S. turkestanica* subsp. *macroglossa* (P.A. Smirn) R. Gonzalo.

5. El resto de las especies de la sección *Stipa* se agrupan bajo la nueva subsect. *pulcherrimae* (Martinovský) R. Gonzalo, que se diferencia de la subsección *Stipa* y *Tirsae* por presentar el lema con las líneas ventrales llegando al ápice y las líneas dorsales y subdorsales fusionadas en la base o la línea dorsal ausente y el ápice de las hojas basales glabro o cortamente ciliado. En esta subsección *Pulcherrimae* se reconocen 10 especies y 5 subespecies.

Se propone el rango subespecífico para *S. epilosa* subsp. *araxensis* (Grosh.) R. Gonzalo y *S. austroitalica* subsp. *sicula* (Moraldo) R. Gonzalo, consideradas hasta el momento como especies *S. araxensis* y *S. sicula*.