



A key to the grasses (Poaceae) of Egypt

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Abstract. A key for identifying 284 native and naturalized Egyptian grass species belonging to 103 genera in 22 tribes and 7 subfamilies is presented. The key is principally based on floral characters of the inflorescence and spikelet. A list and classification of all known species of Egyptian grasses is provided.

Keywords: classification, Gramineae, grasses, Egypt, identification key.

INTRODUCTION

The Poaceae (Gramineae) is a large cosmopolitan family with 768 genera and 11,506 species (Soreng et al. 2017). The family includes cereal grasses, bamboos, and species occurring in natural grasslands, cultivated lawns, and pastures. The family has been divided into subfamilies ranging from two (Tzvelev 1989) to six (Clayton and Renvoize 1986), and more recently the family has been divided into 12 subfamilies (Takhtajan 2009; Reveal 2012; Soreng et al. 2017, 2019; Stevens 2017).

In Egypt the grasses are the largest family of flowering plants with 284 species belonging to 103 genera and 22 tribes (Ibrahim et al. 2016). The most comprehensive account of the family in Egypt was done by Täckholm et al. (1941). Other treatments of the grasses of Egypt include Täckholm (1974), Cope and Hosni (1991), Cope (2005), Boulos (2009), and Ibrahim et al. (2016).

The identification of grasses is usually based on the structure of the inflorescence and floral characteristics. However, in some cases it is necessary to identify grasses by its vegetative character if the flowers are not available. In such cases the vegetative characters can be used until a flowering specimen is obtained (Hosni and Ibrahim 2004; Ibrahim et al. 2016).

Phylogenetic studies using results from DNA sequences have changed the classification of the grasses and this paper follows the current use of a name as proposed in these papers. With the publication of the grasses of Egypt using a vegetative key (Ibrahim et al. 2016), the need for an updated floral key is apparent. Earlier traditional treatments of the grasses of Egypt,

i.e., Cope and Hosni (1991) and Cope (2005) are outdated and it is often difficult to determine the current use name. Our paper presents a new key for the identification of grasses native and adventive in Egypt and is written for use by both trained botanists and interested amateurs. Therefore, we have included an introduction defining many terms used in the key. The key is designed to facilitate the identification and is simplified as much as possible using characters based on the inflorescence and spikelet. Our key refers only to Egyptian specimens and, in addition, we include a updated classification of all grasses found in Egypt.

The accepted names follow the Catalogue of New World Grasses (Soreng et al. 2015, 2017) using terminology found in Kellogg (2015), Clayton et al. (2016), Ibrahim et al. (2016, 2018), and Herrera Arrieta and Peterson (2018). Because the inflorescence of grasses takes a variety of shapes, it is convenient to group them into categories based on their morphology. Accordingly, the identification key is divided into two parts, a key of major groups based mainly on inflorescence characters followed by keys to the species within each group. Brief descriptions, synonyms, and illustrations of the species was provided in Ibrahim et al. (2016). The classification of each species in Table 1 follows Soreng et al. (2017, 2019).

GENERAL MORPHOLOGY

Grasses are annual, biennial or perennial herbs and the root systems are fibrous, rhizomatous or stoloniferous. Flowering stems (culms) are usually unbranched, composed of several internodes and are mostly hollow, rarely solid throughout, and the solid nodes can sometimes be hairy. Leaves are borne solitary at the node and can be crowded at the base of the culm. Each leaf consists of a sheath, ligule and lamina. Leaf blades may be hairy or glabrous. The base of the leaf sheath is attached to the nodes and clasping the stems firmly with overlapping free or connate margins, sometimes with two small falcate or erect outgrowths at the mouth (auricles). At the junction of a sheath and blade is a ligule that can be membranous or hairy (often a line of hairs) but occasionally a ligule can be absent. Leaf sheaths are mostly linear, flat, and sometimes folded or rolled in various ways.

Flowers (Fig. 1) are usually hermaphrodite, sometimes unisexual (male and female), anemophilous (sometimes autogamous, apomictic or entomophilous) small and inconspicuous. The perianth is usually represented by two or three, minute but up to six, inconspicuous

hyaline scales (lodicules) which correspond to the inner perianth whorl of other monocots. Stamens are hypogenous, 1-6 in number but usually 3 with delicate filaments and two anthers that dehisce through terminal pores or longitudinal slits. The ovary is unilocular with a single ovule. There are usually two or three (rarely 1) styles, generally with plumose stigmas. In grasses the fruit or caryopsis is single-seeded with an adherent pericarp, although there are numerous species with free pericarps and these would technically be termed akenes.

The floral parts are placed between two bracts, the lower (lemma) and upper (palea). These two structures are collectively referred to as a floret. The floret is usually subtended by two glumes. Lemmas vary in size and texture like the glumes and differ in the number of veins (usually with an odd number of veins), their overall shape, and the nature of their attachment to the rachilla. Lemmas are often awned or mucronate near the apex, or the awn is borne somewhere along the dorsal back. Awns can be straight, keeled or twisted. The paleas are usually membranous, tightly enclosing the pistil and stamens. Paleas (sometimes reduced) usually have two major veins and are therefore 2-keeled. The lemma, palea, and reproductive structures are called florets. The characteristic floral structure in grasses (spikelets) consist of one to many florets distichously inserted on either side of a slender, jointed rachilla (Fig. 1). Spikelets vary in size from minute (1 mm or less) to relatively large (1 or 2 cm). Each spikelet is usually subtended by two lower empty scales or glumes. Glumes are variously veined and sometimes bear one or more awns. The base of a spikelet or floret is sometimes enlarged and hardened into a small knob or stalk (often sharp) called a callus. Glumes may be shorter than the adjoining lemma or longer and sometimes can be long enough to enclose the entire spikelet, or one or both glumes may be reduced or absent. Spikelets may be dorsiventrally compressed, laterally compressed, or terete.

Table 1. The following list is a synopsis of the classification of the genera into subfamilies and tribes for the grasses of Egypt.

I. Subfamily: ARISTIDOIDEAE Caro

1. TRIBE: ARISTIDEAE C.E.Hubb.

Aristida adscensionis L.

Aristida funiculata Trin. & Rupr.

Aristida mutabilis Trin. & Rupr.

Stipagrostis acutiflora (Trin. & Rupr.) De Winter

Stipagrostis ciliata (Desf.) De Winter

Stipagrostis drarii (Täckh.) De Winter

Stipagrostis hirtigluma (Steud. ex Trin. & Rupr.) De Winter

Stipagrostis lanata (Forssk.) De Winter
Stipagrostis multinerva H. Scholz
Stipagrostis obtusa (Delile) Nees
Stipagrostis paradisea (Edgew.) De Winter
Stipagrostis plumosa (L.) Munro ex T. Anderson
Stipagrostis raddiana (Savi) De Winter
Stipagrostis scoparia (Trin. & Rupr.) De Winter
Stipagrostis shawii (H.Scholz) H.Scholz
Stipagrostis uniplumis (Licht.) De Winter
Stipagrostis vulnerans (Trin. & Rupr.) De Winter

II. Subfamily ARUNDINOIDEAE Kunth ex Beilschm.

2. TRIBE: ARUNDINEAE Dumort.

Arundo donax L.

3. TRIBE: MOLINIEAE Jirásek

Phragmites australis (Cav.) Trin. ex Steud.
Phragmites karka (Retz.) Steud. [syn *Phragmites mauritianus* Kunth]

III. Subfamily CHLORIDOIDEAE Kunth ex Beilschm.

4. TRIBE: CENTROPODIEAE P.M. Peterson, N.P. Barker & H.P. Linder

Centropodia forskalii (Vahl) Cope
Centropodia fragilis (Guinet & Sauvage) Cope

5. TRIBE: CYNODONTEAE Dumort.

Aeluropus lagopoides (L.) Trin. ex Thwaites
Aeluropus littoralis (Gouan) Parl.
Chloris flagellifera (Nees) P.M. Peterson [syn. *Ochthochloa compressa* (Forssk.) Hilu]
Chloris gayana Kunth
Chloris prierurii Kunth [syn *Enteropogon prierurii* (Kunth) Clayton]
Chloris pycnothrix Trin.
Chloris virgata Sw.
Coelachyrum brevifolium Hochst. & Nees
Cynodon dactylon (L.) Pers.
Cynodon transvaalensis Burt Davy
Dactyloctenium aegyptium (L.) Willd.
Dactyloctenium aristatum Link
Dactyloctenium scindicum Boiss.
Desmostachya bipinnata (L.) Stapf
Dinebra retroflexa (Vahl) Panz.
Dinebra panicea (Retz.) P.M.Peterson & N.Snow [syn. *Leptochloa panicea* (Retz.) Ohwi]
Diplachne fusca (L.) P.Beauv. [syn. *Leptochloa fusca* (L.) Kunth]
Eleusine africana Kenn.- O'Byrne

Eleusine coracana (L.) Gaertn.
Eleusine floccifolia (Forssk.) Spreng.
Eleusine indica (L.) Gaertn.
Halopyrum mucronatum (L.) Stapf
Leptothrium senegalense (Kunth) Clayton
Melanocenchris abyssinica (R.Br. ex Fresen.) Hochst.
Schoenefeldia gracilis Kunth
Tetrapogon cenchriformis (A.Rich.) Clayton
Tetrapogon villosus Desf.
Tragus berteronianus Schult.
Tragus racemosus (L.) All.
Trichoneura mollis (Kunth) E.Ekman

6. TRIBE ERAGROSTIDEAE Stapf

Enneapogon desvauxii P.Beauv.
Enneapogon lophotrichus Chiov. ex H.Scholz & P.Koinig
Enneapogon persicus Boiss.
Enneapogon scaber Lehm.
Eragrostis aegyptiaca (Willd.) Delile
Eragrostis aspera (Jacq.) Nees
Eragrostis barrelieri Daveau
Eragrostis cilianensis (All.) Vign. ex Janch.
Eragrostis ciliaris (L.) R. Br.
Eragrostis japonica (Thunb.) Trin.
Eragrostis lepida (A.Rich.) Hochst. ex Steud.
Eragrostis minor Host
Eragrostis pilosa (L.) P.Beauv.
Eragrostis sarmentosa (Thunb.) Trin.
Eragrostis tef (Zucc.) Trotter
Eragrostis tenuifolia (A.Rich.) Hochst. ex Steud.
Eragrostis tremula Hochst. ex Steud.
Schmidtia pappophoroides Steud.

7. TRIBE TRIRAPHIDEAE P.M. Peterson

Triraphis pumilio R.Br.

8. TRIBE ZOYSIEAE Benth.

Sporobolus alopecuroides (Piller & Mitterp.) P.M.Peterson [syn. *Crypsis alopecuroides* (Piller & Mitterp.) Schrad.]
Sporobolus aculeatus (L.) P.M.Peterson [syn. *Crypsis aculeata* (L.) Aiton]
Sporobolus ioclados (Nees ex Trin.) Nees
Sporobolus natalensis (Steud.) T. Durand & Schinz
Sporobolus niliacus (Bornm.) P.M.Peterson [syn. *Crypsis vaginiflora* (Forssk.) Opiz]
Sporobolus spicatus (Vahl) Kunth
Sporobolus pungens (Schreb.) Kunth
Sporobolus schoenoides (L.) P.M.Peterson [syn. *Crypsis schoenoides* (L.) Lam.]
Sporobolus wrightii Munro ex Scribn.

IV. Subfamily DANTHONIOIDEAE H.P. Linder & N.P. Barker

9. TRIBE: DANTHONIEAE Zotov.

Cortaderia selloana (Schult. & Schult. f.) Asch. & Graebn.

Schismus arabicus Nees

Schismus barbatus (L.) Thell.

V. Subfamily: ORYZOIDEAE Kunth ex Beilschm.

10. TRIBE: EHRHARTEAE Nevski

Ehrharta calycina Sm.

11. TRIBE: ORYZEAE Dumort.

Leersia hexandra Sw.

Oryza sativa L.

VI. Subfamily PANICOIDEAE Link

12. TRIBE: ANDROPOGONEAE Dumort.

Andropogon distachyos L.

Chrysopogon plumulosus Hochst.

Chrysopogon zizanioides (L.) Roberty

Coix lacryma-jobi L.

Cymbopogon citratus (DC.) Stapf

Cymbopogon flexuosus (Nees ex Steud.) Watson

Cymbopogon jwarancusa (Jones) Schult.

Cymbopogon martinii (Roxb.) Watson

Cymbopogon nardus (L.) Rendle

Cymbopogon schoenanthus (L.) Spreng. subsp. *schoenanthus*

Cymbopogon schoenanthus subsp. *proximus*

Dichanthium annulatum (Forssk.) Stapf

Dichanthium foveolatum (Delile) Roberty

Elionurus royleanus Nees ex A. Rich

Hemarthria altissima (Poir.) Stapf & C.E. Hubb.

Hyparrhenia hirta (L.) Stapf

Imperata cylindrica (L.) Raeusch.

Lasiurus scindicus Henrard

Miscanthus sinensis Andersson

Pogonatherum paniceum (Lam.) Hack.

Saccharum officinarum L.

Saccharum spontaneum L.

Sorghum arundinaceum (Desv.) Stapf

Sorghum bicolor (L.) Moench

Sorghum x drummondii (Nees ex Steud.) Millsp. & Chase

Sorghum halepense (L.) Pers.

Sorghum virgatum (Hack.) Stapf

Themeda triandra Forssk.

Themeda villosa (Poir.) A. Camus

Vossia cuspidata (Roxb.) Griff.

Zea mays L. subsp. *mays*

Zea mays subsp. *mexicana* (Schrad.) Iltis

13. TRIBE: PANICEAE R.Br.

Cenchrus americanus (L.) Morrone [syn. *Pennisetum glaucum* (L.) R.Br.]

Cenchrus biflorus Roxb.

Cenchrus ciliaris L. [syn. *Pennisetum ciliare* (L.) Link]

Cenchrus clandestinus (Hochst. ex Chiov.) Morrone (syn. *Pennisetum cladestinum* Hochst. ex Chiov.)

Cenchrus echinatus L.

Cenchrus longisetus M.C. Johnst. (syn. *Pennisetum villosum* R. Br. ex Fresen.)

Cenchrus orientalis (Rich.) Morrone (syn. *Pennisetum orientale* Rich.)

Cenchrus pennisetiformis Hochst. & Steud.

Cenchrus ramosissimus Poir. (syn. *Pennisetum ramosissimus* Poir.)

Cenchrus setaceus (Forssk.) Morrone [syn. *Pennisetum setaceum* (Forssk.) Chiov.]

Cenchrus setiger Vahl

Cenchrus sieberianus (Schltdl.) Verloove [syn. *Pennisetum sieberianum* (Schltdl.) Verloove]

Cenchrus violaceus (Lam.) Morrone

Digitaria ciliaris (Retz.) Koeler

Digitaria nodosa Parl.

Digitaria sanguinalis (L.) Scop.

Digitaria velutina (Forssk.) P.Beauv.

Digitaria violascens Link

Echinochloa colona (L.) Link

Echinochloa crusgalli (L.) P.Beauv.

Echinochloa pyramidalis (Lam.) Hitchc. & Chase

Echinochloa stagnina (Retz.) P.Beauv.

Megathyrsus maximus (Jacq.) B.K. Simon & S.W.L. Jacobs (syn. *Panicum maximum* Jacq.)

Melinis minutiflora P.Beauv.

Melinis repens (Willd.) Zizka

Moorochloa eruciformis (Sm.) Veldkamp [syn. *Brachiaria eruciformis* (Sm.) Griseb.]

Panicum antidotale Retz.

Panicum coloratum L.

Panicum hygrophys Steud.

Panicum miliaceum L.

Panicum repens L.

Panicum turgidum Forssk.

Setaria geminata [syn. *Paspalidium geminatum* (Forssk.) Stapf]

Setaria italica (L.) P.Beauv.

Setaria megaphylla (Steud.) T. Durand & Schinz

Setaria obtusifolia (Delile) Morrone [syn. *Paspalidium obtusifolium* (Delile) D. Simpson]

Setaria pumila (Poir.) Roem. & Schult.

Setaria verticillata (L.) P.Beauv.

Setaria viridis (L.) P. Beauv.

Stenotaphrum secundatum (Walter) Kuntze

Tricholaena teneriffae (L.f.) Link

Urochloa deflexa (Schumach.) H.Scholz [syn. *Brachiaria*

deflexa (Schumach.) C.E.Hubb. ex Robyns.]

Urochloa leersioides (Hochst.) H.Scholz & Valdés [syn.

Brachiaria leersioides (Hochst.) Stapf]

Urochloa mutica (Forssk.) T.Q.Nguyen [syn. *Brachiaria*
mutica (Forssk.) Stapf]

Urochloa panicoides P. Beauv.

Urochloa ramose (L.) T.Q.Nguyen [syn. *Brachiaria ramo-*
sa (L.) Stapf]

Urochloa reptans (L.) Stapf [syn. *Brachiaria reptans* (L.)
C.A. Gardner]

14. TRIBE: PASPALEAE J.Presl

Paspalum dilatatum Poirét

Paspalum distichum L.

Paspalum racemosum Lam.

15. TRIBE: TRISTACHYIDEAE Sánchez-Ken & L.G.
Clark

Danthoniopsis barbata (Nees) C.E.Hubb.

VII. Subfamily: POOIDEAE Benth.

16. TRIBE: BRACHYPODIEAE Harz

Brachypodium distachyon (L.) P.Beauv.

17. TRIBE: BROMEAE Dumort.

Bromus aegyptiacus Tausch

Bromus alopecuroides Poir.

Bromus catharticus Vahl

Bromus danthoniae Trin. ex C.A.Mey.

Bromus diandrus Roth var. *diandrus*

Bromus diandrus var. *rigidus* (Roth) Sales

Bromus fasciculatus C.Presl

Bromus hordeaceus L.

Bromus inermis Leyss.

Bromus japonicus Thunb.

Bromus lanceolatus Roth

Bromus lepidus Holmb.

Bromus madritensis L.

Bromus pectinatus Thunb.

Bromus pulchellus Fig. & De Not.

Bromus pumilio (Trin.) P.M. Sm. [syn *Boissiera squarrosa*
(Banks & Sol.) Nevski]

Bromus rubens L.

Bromus scoparius L.

Bromus sterilis L.

Bromus tectorum L. subsp. *tectorum*

Bromus tectorum subsp. *lucidus* Sales

18. TRIBE: LYGEEAE J.Presl

Lygeum spartum Loeff. ex L.

19. TRIBE: MELICEAE Rchb.

Melica persica Kunth

20. TRIBE: POEAE R.Br.

Agrostis stolonifera L.

Alopecurus myosuroides Huds.

Ammochloa palaestina Boiss.

Avena barbata Pott ex Link subsp. *barbata*

Avena barbata subsp. *wiestii* (Steud.) Mansf.

Avena fatua L.

Avena longiglumis Durieu

Avena sativa L.

Avena sterilis L. subsp. *sterilis*

Avena sterilis subsp. *ludoviciana* (Durieu) J.M.Gillet &
Magne

Briza maxima L.

Briza minor L.

Calamagrostis arenaria (L.) Roth [syn. *Ammophila are-*
naria (L.) Link

Catapodium rigidum (L.) C.E.Hubb..

Corynephorus divaricatus (Pourr.) Breistr.

Cutandia dichotoma (Forssk.) Batt. & Trab.

Cutandia maritima (L.) Barbey

Cutandia memphitica (Spreng.) Benth.

Cynosurus echinatus L.

Dactylis glomerata L.

Desmazeria philistaea subsp. *rohlfiana* (Coss.) H.Scholz

Festuca brevis (Boiss. & Kotschy) Asch., Schweinf. &
Muschl. (syn. *Vulpia brevis* Boiss. & Kotschy)

Festuca fasciculata Forssk. [syn. *Vulpia fasciculata* (For-
ssk.) Samp.]

Festuca bromoides L. [syn. *Vulpia bromoides* (L.) Gray]

Festuca myuros L. [syn. *Vulpia myuros* (L.) C.C.Gmel.]

Festuca pectinella Delile [syn. *Vulpia pectinella* (Delile)
Boiss.]

Gastridium phleoides (Nees & Meyen) C.E.Hubb.

Holcus annuus Salzm.

Lagurus ovatus L.

Lamarckia aurea (L.) Moench

Lolium arundinaceum (Schreb.) Darbysh. (syn *Festuca*
arundinacea Schreb.)

Lolium multiflorum Lam.

Lolium perenne L.

Lolium rigidum Gaudin

Lolium temulentum L.

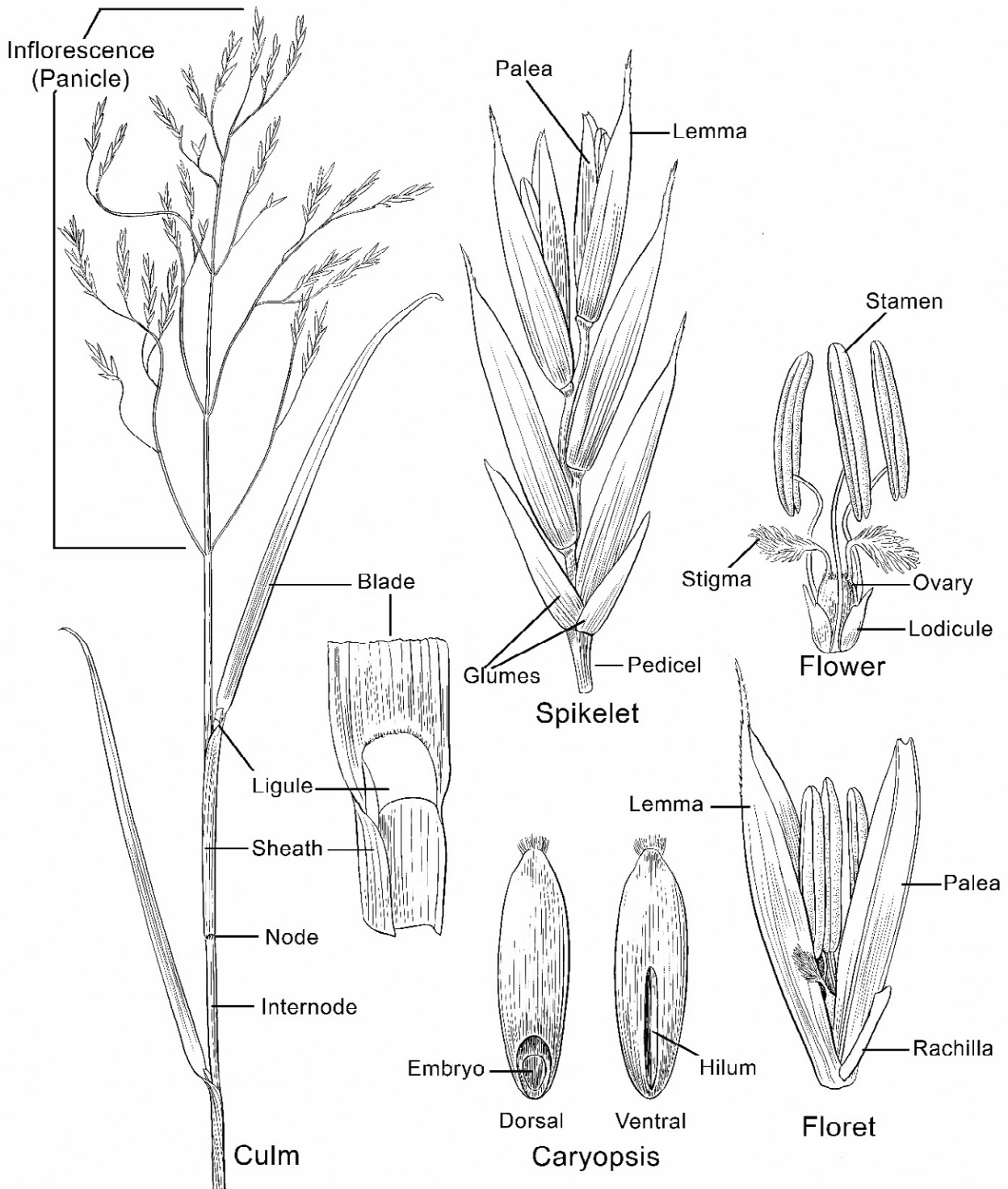


Figure 1. General morphology of a grass, illustrating the culm, blade, panicle, spikelet, floret, flower, and caryopsis.

Parapholis filiformis (Roth) C.E.Hubb.
Parapholis incurva (L.) C.E.Hubb.
Parapholis marginata Runem.

Phalaris aquatica L.
Phalaris arundinacea L.
Phalaris canariensis L.



Figure 2. Inflorescence types used to determine groups in the key. A Open panicle (*Avena sativa*) B Headlike panicle (*Bromus rubens*) C Dichotomously branched panicle (*Cutandia dichotoma*) D Digitately arranged spikes (*Dactyloctenium aegyptium*) E Spikes along central axis (*Dinebra retroflexa*) F Simple spike (*Lolium rigidum*) G Panicles subtended by spatheole (*Lygeum spartum*) H Plumose panicle (*Saccharum spontaneum*) I Spiciform panicle (*Trisetaria linearis*).

Phalaris coeruleascens Desf.
Phalaris minor Retz.
Phalaris paradoxa L.
Phleum pratense L.
Phleum subulatum (Savi) Asch. & Graebn.
Poa annua L
Poa diaphora Trin. [syn. *Eremopoa altaica* (Trin.) Roshev.]
Poa infirma Kunth
Poa persica Trin. [syn. *Eremopoa persica* (Trin.) Roshev.]
Poa sinaica Steudel
Polypogon maritimus Willd.
Polypogon monspeliensis (L.) Desf.
Polypogon viridis (Gouan) Breistr.
Rostraria cristata (L.) Tzvelev
Rostraria hispida (Savi) M.Dogan
Rostraria obtusiflora (Boiss.) Holub subsp. *obtusiflora*
Rostraria pumila (Desf.) Tzvelev
Rostraria rohlfii (Asch.) Holub
Sphenopus divaricatus (Gouan) Rchb.
Triplachne nitens (Guss.) Link
Trisetaria glumacea (Boiss.) Maire
Trisetaria koelerioides (Bornm. & Hack.) Melderis
Trisetaria linearis Forssk.
Trisetaria macrochaeta (Boiss.) Maire

21. TRIBE: STIPEAE Dumort.

Oloptum miliaceum (L.) Röser & H.R.Hamasha [syn.
Oryzopsis miliacea (L.) Asch. & Schweinf.]
Piptatherum holciforme (M.Bieb.) Roem. & Schult. [syn.
Oryzopsis holciformis (M.Bieb.) Hack.]
Stipa arabica Trin & Rupr.
Stipa lagascae Roem. & Schult.
Stipellula capensis (Thunb.) Röser & H.R.Hamasha (syn.
Stipa capensis Thunb.)
Stipellula parviflora (Desf.) Röser & H.R.Hamasha (syn.
Stipa parviflora Desf.)

22. TRIBE: TRITICEAE Dumort.

Aegilops bicornis (Forssk.) Jaub. & Spach
Aegilops geniculata Roth
Aegilops kotschy Boiss.
Aegilops longissima Schweinf. & Muschl.
Aegilops peregrina (Hack.) Eig
Aegilops ventricosa Tausch
Agropyron cristatum (L.) Gaertn.
Crithopsis delileana (Schult.) Roshev.
Elymus elongatus (Host) Runem.
Elymus farctus (Viv.) Runemark ex Melderis
Elymus repens (L.) Gould
Eremopyrum bonaepartis (Spreng.) Nevski
Eremopyrum distans (K.Koch) Nevski

Hordeum marinum Huds. subsp. *marinum*
Hordeum marinum subsp. *gussoneanum*
Hordeum murinum L. subsp. *leporinum* (Link) Arcang.
Hordeum murinum L. subsp. *glaucum* (Steud.) Tzvelev
Hordeum spontaneum K. Koch
Hordeum vulgare L.
Taeniatherum caput-medusae (L.) Nevski
Triticum aestivum L.
Triticum dicoccum (Schrank) Schubl.
Triticum durum Desf.
Triticum pyramidale (Delile ex Schult.) Percival
Triticum turgidum L.

The inflorescence (synflorescence) is usually compound, composed of simple or complex aggregation of primary inflorescences (spikelets) often produced on a central axis (rachis) which may be terminal, rarely axillary, or compound and rebranched (Fig. 2). Spikelets may be arranged in spikes, racemes or panicles (open or contracted). In spikes, the spikelets are attached directly (sessile) to the unbranched main axis without pedicels. Racemes are unbranched inflorescences with each spikelet borne on a single pedicel directly on a branch axis. Multiple racemes can be arranged digitally or scattered along the rachis. Open or contracted panicles are inflorescences in which the main axis has several lateral, whorled or individual indeterminate branches with each branch terminating in a pedicellate spikelet. Spiciform panicles is where contraction has proceeded to the point where individual branches are closely appressed or adherent to the central axis. Inflorescences can sometimes be subtended by a bladeless sheath known as spatheole.

IDENTIFICATION KEY

The identification key is composed of two parts: a key to major groups and a key to each group.

Key to major groups

- 1a. Inflorescence ovoid, cylindrical or a headlike panicle **group 1**
- 1b. Inflorescence open and not ovoid or a headlike panicle ..2
- 2a. Inflorescence branches or spikes digitate or subdigitately inserted, terminal..... **group 2**
- 2b. Inflorescence branches branched and rebranched (paniculate) and not digitately or subdigitately inserted 3

- 3a. Inflorescence with racemes or spike-like panicles terminal; spikelets with an involucre of numerous bristles or hairs at the base **group 3**
- 3b. Inflorescence with racemes appressed along a central axis or a panicle; spikelets without an involucre of numerous bristles or hairs at base..... 4
- 4a. Spikes or racemes appressed along central axes **group 4**
- 4b. Spikes or racemes not appressed along central axes 5
- 5a. Spikelets 3-9-awned or lemma awns 3-branched; inflorescence a contracted or open panicle **group 5**
- 5b. Spikelets 1-awned or unawned; inflorescence a raceme or panicle 6
- 6a. Spikelets prickly; inflorescence a simple raceme or spike-like panicle **group 6**
- 6b. Spikelets not prickly; inflorescence a raceme or panicle .. 7
- 7a. Inflorescence tri- or dichotomously branched **group 7**
- 7b. Inflorescence not tri- or dichotomously branched 8
- 8a. Inflorescence subtended by spatheoles..... **group 8**
- 8b. Inflorescence not subtended by spatheoles..... 9
- 9a. Inflorescence plumose, large 20-60 cm long, open; culms 4-8 m tall **group 9**
- 9b. Inflorescence not plumose, generally ≤ 20 (-60 cm) long, if longer, never plumose, open or contracted; culms ≤ 2 m tall 10
- 10a. Inflorescence a simple spike, raceme or spike-like panicle... **group 10**
- 10b. Inflorescence an open or contracted panicle..... 11
- 11a. Panicles spiciform, narrow usually < 1 cm wide .**group 11**
- 11b. Panicles open usually 0.5-30 cm wide..... 12
- 12a. Panicles contracted, 0.5-3 (-4) cm wide **group 12**
- 12b. Panicles open, not contracted, usually (2-) 4-30 cm wide. 13
- 13a. Spikelets awned **group 13**
- 13b. Spikelets unawned..... **group 14**
- 2a. Spikelets not subtended by bristles, 1-flowered with a single perfect floret; glumes (5.5-) 7-10 mm long, awned, the awns 1.5-3 mm long..... *Lagurus ovatus*
- 2b. Spikelets subtended by an involucre of bristles, 2-flowered, the lower floret sterile; glumes 0.3-5.2 mm long, unawned *Cenchrus longisetus*
- 3a. Spikelets subtended by an involucre of bristles, bristles plumose, 4-7 cm long *Cenchrus longisetus*
- 3b. Spikelets not subtended by an involucre of bristles 4
- 4a. Panicle bilateral, pyramidal; cultivated *Triticum pyramidale*
- 4b. Panicle not pyramidal; native 5
- 5a. Stoloniferous perennials; with stringlike culms, richly branched at the nodes *Aeluropus lagopoides*
- 5b. Plants not stoloniferous; culms erect..... 6
- 6a. Glumes shiny with attenuate apices; lemmas shiny, surface villous, hairy below, hairs 4-8 mm long, apex setaceous or attenuate..... *Cortaderia selloana*
- 6b. Glumes and lemmas green and not shiny, with acute and/or mucronate apices..... 7
- 7a. Panicles subtended by an inflated sheath, or spatheole; spikelets 1-flowered 8
- 7b. Panicles not subtended by an inflated leaf sheath or spatheole; spikelets 2-many-flowered..... 10
- 8a. Panicles ellipsoid; lower glume with glabrous margins *Sporobolus schoenoides*
- 8b. Panicles ovoid or ellipsoid, lower glumes with hairy margins..... 9
- 9a. Panicles 0.5-1 cm long; uppermost leaf continuous with its sheath; paleas 0-1-veined *Sporobolus aculeatus*
- 9b. Panicles 0.3-1.5 cm long; uppermost leaf clearly demarcated from its sheath; paleas 2-veined .. *Sporobolus niliacus*
- 10a. Lemmas unawned 11
- 10b. Lemmas awned..... 12
- 11a. Spikelets 4-14-flowered; panicles exerted *Ammochloa palaestina*
- 11b. Spikelets 3-flowered with only one fertile floret; panicles partially included in the sheath *Phalaris minor*
- 12a. Glumes dissimilar; lemmas mucronate or short-awned, the awns ≤ 1.5 mm long *Dactylis glomerata*
- 12b. Glumes similar; lemmas all awned, awns ≥ 2 mm long . 13
- Group 1: Inflorescence ovoid, cylindrical or a headlike panicle*
- 1a. Heads woolly with plumose hairs or bristles 2
- 1b. Heads not woolly 3

- 13a. Most florets perfect; sheaths pubescent to pilose 14
- 13b. Florets both sterile and perfect; sheaths glabrous 15
- 14a. Spikelets 15–30 mm long; lemmas 10–15 mm long, awns 7–23 mm long *Bromus rubens*
- 14b. Spikelets 4–5 mm long; lemmas 3–4.5 mm long, awns 3–5 mm long *Rostraria hispida*
- 15a. Awns of sterile spikelets 15–20 mm long; spikelets 6–7 mm long; lemmas 3.4–4 mm long *Cynosurus coloratus*
- 15b. Awns of sterile spikelets 6–15 mm long; spikelets 8–14 mm long; lemmas 4–6.5 mm long *Cynosurus echinatus*
- Group 2: Inflorescence branches or spikes digitate or sub-digitately inserted, terminal*
- 1a. Racemes 1–2 (3) digitate 2
- 1b. Racemes usually 2 or more 8
- 2a. Lemmas awned 3
- 2b. Lemmas unawned 4
- 3a. Racemes subtended by reddish spatheole; rachis with white hairs; lemma awns 10–35 mm long, geniculate with twisted column *Hyparrhenia hirta*
- 3b. Racemes not subtended by spatheole; rachis glabrous; lemma awns 7–10 mm long, straight *Brachypodium distachyon*
- 4a. Culms spongy; racemes 10–30 cm long; rachis angular; glumes with long caudate apex *Vossia cuspidata*
- 4b. Culms not spongy; racemes ≤ 15.5 cm long; rachis winged or flattened; glumes without a caudate apex 5
- 5a. Spikelets 4–7-flowered, 3.3–7.8 mm long 6
- 5b. Spikelets 1 or 2-flowered, when 2-flowered the lower floret sterile, 2–3.2 mm long 7
- 6a. Leaf blades with tufts of short white hairs scattered along the margins; upper glumes 1-veined; grain rugulose *Eleusine floccifolia*
- 6b. Leaf blades without tufts of hairs scattered along the margins; upper glumes 2–3-veined; grains striate *Eleusine indica*
- 7a. Racemes 2–8 cm long; rachis narrowly winged; spikelets dorsally compressed *Paspalum distichum*
- 7b. Racemes 0.7–1.5 cm long; rachis flattened; spikelets laterally compressed *Cynodon transvaalensis*
- 8a. Lemmas awned 9
- 8b. Lemmas unawned or short aristate 16
- 9a. Lemmas with geniculate awns and twisted columns 10
- 9b. Lemmas with straight or flexuous awns 12
- 10a. Upper glume awned, the awn 4–10 mm long; fertile spikelets 8–16 mm long *Andropogon distachyos*
- 10b. Upper glume unawned; fertile spikelets 2–7 mm long ... 11
- 11a. Racemes 3–7 cm long; lemma apex entire, awns 8–25 mm long, adventive *Dichanthium annulatum*
- 11b. Racemes 10–30 cm long; lemmas apex bifid, awns 6–12 mm long, cultivated *Miscanthus sinensis*
- 12a. Lemmatal awns flexuous, 10–30 (–40) mm long; glumes 1-awned, awns 0.5–1 mm long *Schoenefeldia gracilis*
- 12b. Lemmatal awns straight, less than 10 mm long 13
- 13a. Lemmatal awns 0.5–5 mm long, as long as lemma *Chloris gayana*
- 13b. Lemmatal awns more than 5 mm long, more than twice as long as lemma 14
- 14a. Leaf blade with an obtuse apex; glume apex acute *Chloris pycnothrix*
- 14b. Leaf blade with an acute apex; glume apex acuminate ... 15
- 15a. Lowest lemma without a crown of spreading hairs; spikelets 4–6-flowered *Chloris prieurii*
- 15b. Lowest lemma with a crown of long spreading hairs, the hairs 1.5–4 mm long; spikelets 3 flowered .. *Chloris virgata*
- 16a. Flowers unisexual, plants monoecious, female inflorescences subtended by leafy spatheoles, rachis enlarged into a woody cob 17
- 16b. Flowers perfect, plants hermaphroditic, inflorescences not subtended by spatheoles and rachis not enlarged into a cob 18
- 17a. Female inflorescences 2–5 (–10) cm thick with 8–24 rows of spikelet pairs forming a thick woody cob, all tightly enclosed by several leafy spatheoles *Zea mays* subsp. *mays*
- 17b. Female inflorescences less than 1 cm thick with 2 rows of spikelet pairs forming a hardened rachis, all enclosed by a single leafy spatheole *Zea mays* subsp. *mexicana*
- 18a. Racemes 1–2 mm broad 19
- 18b. Racemes 2–5 mm broad 23
- 19a. Glumes equal; racemes 3–5 *Chloris flagellifera*
- 19b. Glumes unequal or absent; racemes 2–16 20

- 20a. Spikelets 1-flowered; racemes 2 or more closely placed or whorled with a flat rachis, unwinged; ligule a ciliate membrane *Cynodon dactylon*
- 20b. Spikelets 2-flowered; racemes mostly in pairs or whorled or alternate, the rachis flat or triquetrous, winged; ligule membranous 21
- 21a. Glumes two, dissimilar *Digitaria ciliaris*
- 21b. Glume one, the lower absent or obscure 22
- 22a. Spikelets 2.5–3.3 mm long; fertile spikelets paired along a narrowly winged rachis *Digitaria sanguinalis*
- 22b. Spikelets 1.2–2 mm long; fertile spikelets ternate along a broadly winged rachis *Digitaria violascens*
- 23a. Racemes terminated by the naked tips of the rachis, bristle like 24
- 23b. Racemes terminated by a spikelet 26
- 24a. Racemes 1.2–6.5 cm long, inflorescence open
..... *Dactyloctenium aegyptium*
- 24b. Racemes 0.8–2 cm long, inflorescence compact 25
- 25a. Stoloniferous perennials; anthers 1.1–2 mm long
..... *Dactyloctenium scindicum*
- 25b. Tufted annuals often rooting at the lower nodes; anthers 0.3–0.5 mm long *Dactyloctenium aristatum*
- 26a. Racemes in terminal pairs (rarely 3) with scattered one or two below; spikelets 8–20-flowered *Acrachne racemosa*
- 26b. Racemes not in terminal pairs, digitate or subdigitately arranged; spikelets 3–9-flowered 27
- 27a. Upper glume apex obtuse; lemma apex obtuse
..... *Coelachyrum brevifolium*
- 27b. Upper glume apex acute; lemma apex acute 28
- 28a. Racemes 9–15 mm wide; spikelets ovate; grains subglobose, brown, exposed between gaping lemmas and paleas at maturity, cultivated *Eleusine coracana*
- 28b. Racemes 3–8 mm wide; spikelets elliptic; grains ellipsoid, blackish, not exposed or concealed by the florets, native and/or weedy 29
- 29a. Leaf blades with tufts of short white hairs scattered along the margins; upper glumes 1-veined; grain rugulose
..... *Eleusine floccifolia*
- 29b. Leaf blades without tufts of hairs scattered along the margins; upper glumes 2–3-veined; grains striate or granular ...
..... 30
- 30a. Lemmas 2.1–3.6 mm long; racemes 3–3.5 mm wide; grains 1–1.3 mm long, striate *Eleusine indica*
- 30b. Lemmas 3.7–5 mm long; racemes 4–8 mm wide; grains 1.2–1.6 mm long, granular *Eleusine africana*
- Group 3: Inflorescence with racemes or spike-like panicles terminal; spikelet with an involucre of numerous bristles or hairs at the base*
- 1a. Inflorescence 1 or 2 digitate racemes; spikelets surrounded by hairs; lemmatal awns 2–4 mm long, straight
..... *Tetrapogon villosus*
- 1b. Inflorescence a panicle; spikelets surrounded by free or connate bristles; lemmas unawned 2
- 2a. Plants robust 2–3 m tall 3
- 2b. Plants 90 cm or less tall 4
- 3a. Annuals; culms glabrous below the panicle; bristles shorter than the spikelets, persistent; cultivated
..... *Cenchrus americanus*
- 3b. Perennials; culms villous below the panicle; bristles much longer than the spikelets, deciduous; indigenous
..... *Cenchrus orientalis*
- 4a. Bristles connate, deciduous with the spikelets, inner bristles longer than outer with one long bristle, flat 5
- 4b. Bristles free, not deciduous with the spikelet 9
- 5a. Bristles of the involucre retrorsely barbellate, tenaciously clinging to clothing, longest bristles scarcely emergent ... 6
- 5b. Bristles of the involucre antrorsely scaberulous not clinging; sometimes with one conspicuous longer bristle 7
- 6a. Inner bristles connate only at the bases to form a shallow disc, 2–4 mm long; inner bristle 2.9–7 mm long; ciliate
..... *Cenchrus biflorus*
- 6b. Inner bristles fused for about half their length to form a cup, 5–10 mm long; longest bristle 2–5 mm long, pubescent spinose *Cenchrus echinatus*
- 7a. Inner bristles rigid, flattened, 2–3 mm long, connate for ½–2/3 their length forming a cup, inner bristles with longest bristle scarcely emergent; 2–4 mm long
..... *Cenchrus setiger*
- 7b. Inner bristles flexuous, filiform above, 6–12 mm long, inner bristles with one conspicuously longer bristle 8–16 mm long; ciliate 8
- 8a. Inner bristles united only at the bases to form shallow disc 0.5–1.5 mm diam., occasionally connate for up to 0.5 mm above its rim *Cenchrus ciliaris*
- 8b. Inner bristles connate for 1–2.5 mm above the rim of the basal disc forming a cup *Cenchrus pennisetiformis*

- 9a. Bristles persistent 10
- 9b. Bristles deciduous with the spikelets 14
- 10a. Inflorescences open panicles, bristles 2-2.5 cm long
..... *Setaria megaphylla*
- 10b. Inflorescences a spiciform panicles 11
- 11a. Bristles retrorsely barbed clinging to clothes, 4-7 mm long
..... *Setaria verticillata*
- 11b. Bristles antrorsely barbed 12
- 12a. Upper glumes as long as the spikelets; each spikelet sub-
tended by 1-3 bristles, 5-10 times as long as the spikelets.
Setaria viridis
- 12b. Upper glumes shorter than the spikelets 13
- 13a. Lemmas strongly rugose; each spikelets subtended by
4-12 bristles, 3-8 mm long *Setaria pumila*
- 13b. Lemmas rugulose or unwrinkled; each spikelet subtended
by 1-3 bristles, 4-16 mm long *Setaria italica*
- 14a. Inflorescences comprising only a few spikelets; compris-
ing 2-4(-6) fertile spikelets; shorter than basal leaves;
subtended by an inflated leaf-sheaths; enclosed; bristles
shorter than the spikelets (cult.) ... *Cenchrus clandestinum*
- 14b. Inflorescences spike-like panicles, exserted 15
- 15a. Panicles ovoid to subspherical very dense; bristles plu-
mose, 40-70 mm long; lemmas acute, 7-9-veined
..... *Cenchrus longisetus*
- 15b. Panicles elongate; lemmas 16
- 16a. Involucre sessile *Cenchrus violaceum*
- 16b. Involucre stipitate (stalked) 17
- 17a. Plants glaucous, pinkish; spikes purple or pink; involucre
base stipitate, the stipe 1-3 mm long *Cenchrus setaceus*
- 17b. Plants not glaucous, not pinkish; involucre base stipitate,
the stipe 0.5-1 mm long 18
- 18a. Panicles axes glabrous; involucre bristles 7-20 mm long ..
..... *Cenchrus ramosissimus*
- 18b. Panicles axes pubescent; involucre bristles 6-9 mm long
with a conspicuous longer bristle, 10-25 mm long
..... *Cenchrus sieberianus*
- 1b. Spikelets not headlike, erect or reflexed along the central
axis but not nodding; glumes not long villous 2
- 2a. Glumes as long as or longer than the spikelets, persistent,
similar, exceeding apex of florets; lower glume apex cau-
date *Dinebra retroflexa*
- 2b. Glumes much shorter than the spikelets; lower glume
apex not caudate 3
- 3a. Racemes 0.5-1 cm long; spikelets embedded in a corky
rachis; leaf blade apex obtuse *Stenotaphrum secundatum*
- 3b. Racemes more than 1 cm long, not embedded in rachis;
leaf blades apex acute 4
- 4a. Lemmas and/or glumes acuminate or awned 5
- 4b. Lemmas or glumes unawned 9
- 5a. Racemes 15-35 cm long; spikelets 8-15 mm long; lemma
apex mucronate or with a short awn ≤ 1.5 mm long; fer-
tile spikelets pedicelled, pedicels filiform, 0.5-1.5 mm
long; glumes unequal *Diplachne fusca*
- 5b. Racemes 2-10 cm long; spikelets 3-6 mm long; lemma
apex awned; fertile spikelets sessile or with pedicels <0.5
mm long; glumes equal or subequal 6
- 6a. Lemmas apex mucronate or short awned, the awns 0.3-3
mm long 7
- 6b. Lemmas awned, the awn 20-50 mm long 8
- 7a. Racemes 2-7(-10); spikelets comprising 1 fertile floret;
spikelets 3-4.5 mm long; lemmas rugulose, mucronate,
the mucro 0.3-1 mm long *Urochloa panicoides*
- 7b. Racemes 10-40; spikelets comprising 5-9 fertile florets;
spikelets 6-8 mm long; lemmas sparingly hairy, mucro-
nate or short awned up to 2 mm long ... *Trichoneura mollis*
- 8a. Caespitose annuals; racemes straight; spikelets pedicelled,
1-2 mm long; lemmas hispid, awns up to 50 mm long;
upper glumes apex cuspidate *Echinochloa crusgalli*
- 8b. Rhizomatous perennials; racemes flexuous; spikelets ses-
sile to subsessile; lemmas pubescent, awns 20 mm long,
upper glumes entire or awned, the awns 0-4 mm long
..... *Echinochloa stagnina*
- 9a. Rachis winged 10
- 9b. Rachis unwinged 15
- 10a. Racemes compact, appressed to the long slightly hollowed
common axis; leaf blade apex obtuse *Setaria obtusifolia*
- 10b. Racemes not compact, and not as above; leaf apex acute 11
- 11a. Spikelets 6-9 mm long; lemma margin and midvein
pubescent; glume apex caudate *Dinebra panicea*
- Group 4: Spikes or racemes appressed along central axes*
- 1a. Spikelets headlike, several, small, nodding along an
unbranched axes; glumes long villous and soft
..... *Melanocenthris abyssinica*

- 11b. Spikelets 1.5-4 mm long; lemmas glabrous; glume apex acute to obtuse 12
- 12a. Spikelets 2.5-3.5 mm long; rachis broadly winged, the wing 0.5-2 mm wide; lemmas apex obtuse..... 13
- 12b. Spikelets 1.5-2.5 mm long; rachis narrowly winged, the wing < 0.5 mm wide; lemma apex acute 15
- 13a. Lower glumes absent or obscure..... *Paspalum racemosum*
- 13b. Both glumes present, dissimilar 14
- 14a. Racemes 5-20 cm long; spikelets 2.5-3.5 mm long; lemma surfaces rugulose, stramineous *Urochloa mutica*
- 14b. Racemes 0.5-4 cm long; spikelets 1.5-2.5 mm long; lemma surface smooth, shiny, dark brown.....
..... *Setaria geminata*
- 15a. Glume one, the lower absent or obscure 16
- 15b. Glumes 2, the lower present..... 17
- 16a. Glumes apex obtuse; lemmas 3-veined
..... *Paspalum dilatatum*
- 16b. Glumes apex acute; lemmas 7-veined *Digitaria velutina*
- 17a. Inflorescences up to 60 cm long, racemes numerous 20-50 or more *Desmostachya bipinnata*
- 17b. Inflorescences <60 cm long, racemes few, up to 10..... 18
- 18a. Lemma and glume apices obtuse... *Moorochloa eruciformis*
- 18b. Lemma and glume apices acute or cuspidate 19
- 19a. Spikelets with 8-25 florets..... 20
- 19b. Spikelets with 1 fertile and 1 sterile floret 21
- 20a. Rachilla villous; callus bearded.... *Halopyrum mucronatum*
- 20b. Rachilla glabrous; callus not bearded
..... *Catapodium rigidum*
- 21a. Lower glume apex obtuse; lemmas pilose or villous, bearing white hairs *Digitaria nodosa*
- 21b. Lower glume apex acute; lemmas not pilose or villous .. 22
- 22a. Spikelets packing adaxial, distant, irregular.....
..... *Urochloa deflexa*
- 22b. Spikelets packing regular, 2- or 4-6-rowed 23
- 23a. Spikelets packing regular, 2-rowed 24
- 23b. Spikelets packing regular, 4-6-rowed 27
- 24a. Spikelets packing broadside to rachis; glume apex obtuse and erose, lemma apex apiculate *Aeluropus littoralis*
- 24b. Spikelets not packing broadside to rachis; glume apex acute, not erose; lemmas apex acute, often mucronate 25
- 25a. Spikelets 1.5-2 mm long with hirsute pedicels; lower glumes 0.15-0.25 as long as the spikelets without veins, apex truncate *Urochloa reptans*
- 25b. Spikelets 2-3.5 mm long with glabrous or scabrous pedicels; lower glumes 1/3-1/2 as long as the spikelets with 3-7 veins, apex acute or obtuse 26
- 26a. Lemmas dark brown; upper glumes not separated from lower glumes by an internode..... *Urochloa ramosa*
- 26b. Lemmas green; the upper glumes separated from the lower glumes by a distinct internode 0.2-0.5 mm long
..... *Urochloa leersioides*
- 27a. Plants annual, caespitose; upper glumes pubescent, apex cuspidate *Echinochloa colona*
- 27b. Plants perennial with rhizomes; upper glumes glabrous or hispidulous, apex acute *Echinochloa pyramidalis*
- Group 5: Spikelets 3-9-awned or lemma awns 3-branched; inflorescence a contracted or open panicle*
- 1a. Lemmas 5-9-awned 2
- 1b. Lemmas awns 3, or awns 3-branched 7
- 2a. Panicles open or contracted; lemmas hairy below the middle, 5-awned, the awns 4-8 mm long.....
..... *Schmidtia pappophoroides*
- 2b. Panicles compact or spiciform; lemmas not hairy; lemmas 5-9-awned 3
- 3a. Small villous grasses; panicles densely ovoid; lemmas with 5-9 scabrid awns *Bromus pumilio*
- 3b. Tall, glabrous grasses, panicles spiciform, oblong-linear; lemma awns 9, feathery..... 4
- 4a. Lemmas awns scaberulous throughout
..... *Enneapogon scaber*
- 4b. Lemmas awns ciliate below, scaberulous only towards tip..
..... 5
- 5a. Fertile lemmas with 3 dense patches of hairs on the backs, one along midrib and one along each margin; nodes glabrous *Enneapogon lophotrichus*
- 5b. Lemmas with hairs on the back evenly distributed; nodes bearded..... 6
- 6a. Basal leaf sheaths persistent, forming a bulbous swelling near base; spikelets 2.8-5.5 mm long
..... *Enneapogon desvauxii*

- 7a. Basal leaf sheaths persistent, not forming a bulbous swelling near base; spikelets 5.5-12 mm long.....
.....*Enneapogon persicus*
- 7a. Lemma awns glabrous to scabrous, column not twisted .. 8
- 7b. Lemma awns feathery, at least the principal or central awn with atwisted column..... 14
- 8a. Lemma 3-awned, central awn arising from sinus and the lateral awns arising dorsally or marginally, persistent, central awn not more than 10 mm long, lateral awns not more than 5 mm long 9
- 8b. Lemma with a single 3-branched awn, deciduous, central awn more than 10 mm long, lateral awns usually more than 5 mm long..... 15
- 9a. Central lemma awns geniculate with twisted column, apex of awn smooth..... 10
- 9b. Central lemma awn straight, apex of awn scabrous..... 13
- 10a. Central lemma awns inserted below the middle, scarcely exerted from the spikelet, the awns 2.5-3 mm long, lateral lemma awns 1-1.5 mm long..... *Trisetaria glumacea*
- 10b. Central lemma awns inserted near the middle or upper $\frac{1}{4}$, exerted from the spikelet, the awns 3-10 mm long, lateral lemma awns 1-5 mm long..... 11
- 11a. Lemmas glabrous, central awns 5-7 mm long; lateral awns 1.5-5 mm long 12
- 11b. Lemmas villous, central awns 3-4 mm long, lateral awns 1-1.5 mm long..... *Triplachne nitens*
- 12a. Panicles loosely contracted, 0.5-3.5 cm wide, oblong-ovate; central lemma awn 5-8 mm long, lateral awns 1.5 mm long *Trisetaria macrochaeta*
- 12b. Panicles densely contracted, 0.5-1 cm wide, linear; central lemma awn 8-15 mm long, lateral awns 3-5 mm long
..... *Trisetaria linearis*
- 13a. Spikelets elliptic, 10-40 mm long; lemmas with minutely bifid apex, awns curved, spreading, 5-15 mm long, lateral lemma awns arising dorsally, shorter than the central
..... *Bromus danthoniae*
- 13b. Spikelets lanceolate, 4-6 mm long; lemmas central awns 1.5-3 mm long, lateral lemma awns arising from the margins 0.5-1 mm long 25
- 14a. Spikelets 5-11-flowered; glumes 1.5-3 mm long, shorter than the spikelet; lemmas pilose, margins ciliate, central awn inserted in the sinus, the awn 1.5-2.5 mm long, not geniculate or twisted *Triraphis pumilio*
- 14b. Spikelets 2-flowered; glumes 4-5 mm long, longer than the spikelet; lemmas entirely glabrous, shiny, central awn inserted dorsally on upper $\frac{1}{2}$, the awn 2.5-3 mm long, geniculate and twisted *Trisetaria glumacea*
- 15a. All three awns glabrous, lateral awns as long as the central awn; glumes unequal..... 16
- 15b. Central and sometimes lateral awns plumose, lateral awns shorter than the central; glumes subequal..... 18
- 16a. Awns without a column, not articulating at the summit; ligule a ciliolate membrane..... *Aristida adscensionis*
- 16b. Awns with a column, articulating at the summit; ligule a fringe of hairs 17
- 17a. Spikelets 6-7 mm long; lemma awns 10-30 mm mm long
..... *Aristida mutabilis*
- 17b. Spikelets 20-30 mm long; lemma awns 35-45 mm long
..... *Aristida funiculata*
- 18a. All three lemma awns plumose, lateral awns about as long as the central awn with or without a twisted column 19
- 18b. Only the central lemma awn plumose, lateral awns much shorter than the central awn with a twisted column 21
- 19a. Internodes densely woolly; panicles 5-10 cm long; central lemma awns 20-35 mm long, the column 3-5 mm long, twisted *Stipagrostis lanata*
- 19b. Internodes glabrous; panicles 10-40 cm long; central lemmas awns 7-10 mm long, the column 0-1 mm long, straight or slightly twisted 20
- 20a. Lower glumes longer than the upper; panicles 20-40 cm long; awns not or scarcely exerted from spikelets.....
..... *Stipagrostis scoparia*
- 20b. Lower glumes shorter than the upper; panicles 10-20 cm long; awns exerted from the spikelets.....
..... *Stipagrostis vulnerans*
- 21a. Nodes bearded; lemmas articulating near the middle (across the body) *Stipagrostis ciliata*
- 21b. Nodes not bearded; lemmas articulating near apex..... 22
- 22a. Central lemma awns plumose throughout 23
- 22b. Central lemma awns glabrous in the lower and/or upper portions 25
- 23a. Callus glabrous; column straight or slightly twisted
..... *Stipagrostis raddiana*
- 23b. Callus bearded; column twisted..... 24
- 24a. Callus with 2 collars of hairs; column 7-13 mm long, hairy on the upper portion; central lemma awns 35-70 mm long, lateral lemma awns 10-25 mm long
..... *Stipagrostis hirtigluma*
- 24b. Callus with a single collar of hairs; column 5-10 mm long, glabrous; central lemma awns 20-35 mm long, lateral lemma awns 10-12 mm long *Stipagrostis uniplumis*

- 25a. Central lemma awns glabrous in the lower or upper portion..... 26
- 25b. Central lemma awns glabrous in the lower and upper portion..... 29
- 26a. Central lemma glabrescent toward tip 27
- 26b. Central lemma awns glabrescent toward base 28
- 27a. Callus glabrous; column 1.5–2 mm long; central lemma awns 13–25 mm long, lateral lemma awns 7–17 mm long *Stipagrostis drarii*
- 27b. Callus bearded; column 11–14 mm long; central lemma awns 60–70 mm long, lateral lemma awns 17–25 mm long *Stipagrostis paradisea*
- 28a. Lower glume apex obtuse; lemmas 2–2.5 mm long, central lemma awns 20–30 mm long, *Stipagrostis obtusa*
- 28b. Lower glume apex acute; lemmas 3–4 mm long, central lemma awns 45–47 mm long *Stipagrostis shawii*
- 29a. Column straight or slightly twisted, 1 mm long, central lemma awns 13–18 mm long..... *Stipagrostia acutiflora*
- 29b. Column twisted, 3–9 mm long, central lemma awns 25–60 mm long 30
- 30a. Glumes 3-veined, lower glumes glabrous *Stipagrostis plumosa*
- 30b. Glumes 5-7-veined, lower glumes pilose *Stipagrostis multinerva*

Group 6: Spikelets prickly; inflorescence a simple raceme or panicle

- 1a. Lower glumes well developed, modified into a long flat recurved tail, upper glumes usually smaller, enfolding the lemmas, tuberculate *Leptothrium senegalense*
- 1b. Lower glumes very small or suppressed, upper glumes and lemmas about equal with raised veins bearing hooked bristles 2
- 2a. Apical spikelets sterile; upper glumes 7-veined *Tragus racemosus*
- 2b. All spikelets fertile; upper glumes 5-veined *Tragus berteronianus*

Group 7: Inflorescence tri- or dichotomously branched

- 1a. Panicles trichotomously branched and rebranched; spikelets 2 mm long; pedicels terete, club-shaped, slender *Sphenopus divaricatus*

- 1b. Panicles dichotomously branched; spikelets 6–8 mm long; pedicels 3-angled..... 2
- 2a. Spikelets 5–9 (–12)-flowered; glumes 3–5-veined *Cutandia maritima*
- 2b. Spikelets 2–4-flowered; glumes 1-veined..... 3
- 3a. Panicles partially enclosed in the sheath below; panicle internodes longer in length than the spikelets; lemmas 7.5– 8.5 mm long, apex awned, the awns 10–11 mm long *Cutandia memphetica*
- 3b. Panicles exerted not enclosed in the sheath; panicle internodes shorter in length than the spikelets; lemmas 4.5–5.5 mm long, apex acute or bidentate *Cutandia dichotoma*

Group 8: Inflorescence subtended by spatheoles

- 1a. Inflorescence a single terminal spikelet, one-sided enclosed by spatheole; lemmas villous..... *Lygeum spartum*
- 1b. Inflorescence composed of many spikelets; lemmas not villous 2
- 2a. Inflorescence composed of male and female racemes..... 3
- 2b. Inflorescence composed of bisexual florets 5
- 3a. Female racemes sessile subtended by bony utricles; male racemes pedunculate projecting from the utricles *Coix lacryma-jobi*
- 3b. Female racemes subtended by 1 or more herbaceous spatheoles..... 4
- 4a. Female inflorescences 2–5 cm broad; rachises thick woody, enclosed by several leafy spatheoles..... *Zea mays* subsp. *mays*
- 4b. Female inflorescences less than 1 cm broad; rachises tough not woody, enclosed by single spatheole *Zea mays* subsp. *mexicana*
- 5a. Rachis with white hairs..... *Hyparrhenia hirta*
- 5b. Rachis pubescent or glabrous but not with white hairs.... 6
- 6a. Spatheoles colored red or brown 7
- 6b. Spatheoles green..... 9
- 7a. Plants not aromatic; spikelets 6–14 mm long surrounded by hairs; callus bearded, the hairs red; lemma awns 20–70 mm long, straight, hispidulous *Themeda triandra*
- 7b. Plants aromatic; spikelets 4–5.5 mm long; callus not bearded; lemma awns 7–18 mm long, geniculate with a twisted column..... 8

- 8a. Lower glume of sessile spikelet veins distinct, winged; lemma awns 12-18 mm long..... *Cymbopogon martini*
- 8b. Lower glume of sessile spikelet veins absent or obscure and not winged; lemma awns 7-10 mm long.....
.....*Cymbopogon jwarancusa*
- 9a. Rachis villous; spikelet pedicels villous; lemmas unawned.
..... *Cymbopogon citratus*
- 9b. Rachis ciliate; spikelet pedicels ciliate; lemmas awned ... 10
- 10a. Awns geniculate with a twisted column..... 11
- 10b. Awns straight..... 14
- 11a. Plants aromatic; racemes 2 12
- 11b. Plants not aromatic; racemes 1 13
- 12a. Lower glume of sessile spikelet elliptic lanceolate, usually 2- or 3-veined between the keels *Cymbopogon nardus*
- 12b. Lower glume of sessile spikelet narrowly lanceolate, usually veinless between the keels *Cymbopogon flexuosus*
- 13a. Lower glume of sessile spikelet pubescent with reddish hairs and not pitted, apex obtuse; lemma awns absent or to 10 mm long..... *Themeda villosa*
- 13b. Lower glumes of sessile spikelet glabrous, shining, pitted, apex acute; lemma awns 12-18 mm long.....
..... *Dichanthium foveolatum*
- 14a. Racemes 2-3 cm long; spatheoles 2-3 cm long; lower glume of sessile spikelet glabrous
..... *Cymbopogon schoenanthus* subsp. *schoenanthus*
- 14b. Racemes 1-2 cm long; spatheoles 1-2 cm long; lower glume of sessile spikelet pubescent.....
..... *Cymbopogon schoenanthus* subsp. *proximus*
- Group 9: Inflorescence plumose, large 20-60 cm long, open; culms 4-8 m tall*
- 1a. Culms solid; callus bearded with white silky hairs..... 2
- 1b. Culms not solid; callus not bearded..... 3
- 2a. Callus hairs white; panicles 25-40 cm long.....
..... *Saccharum spontaneum*
- 2b. Callus hairs off-white; panicles up to 1 m long.....
..... *Saccharum officinarum*
- 3a. Lemmas pilose, the hairs 4-9 mm long; rachilla glabrous; glumes longer than the florets..... *Arundo donax*
- 3b. Lemmas glabrous, rachilla hairy; glumes shorter than the florets..... 4
- 4a. Rachilla hairs 4-7 mm long; upper glumes 3-5(-6) mm long; leaf blades scabrid below..... *Phragmites karka*
- 4b. Rachilla hairs 8-15 mm long; upper glumes 6-9 mm long; leaf blades smooth below..... *Phragmites australis*
- Group 10: Inflorescence a simple spike, raceme or spike-like panicle*
- 1a. Inflorescence a fragile cylindrical bilateral raceme with spikelets sunken in hollow of axes, glumes placed side by side covering the hollow 2
- 1b. Inflorescence not as above and without any sunken spikelets along the axis..... 4
- 2a. Keel of glume wingless; culms and racemes strongly curved..... *Parapholis incurva*
- 2b. Keel of glume winged; culms and racemes usually straight 3
- 3a. Racemes bearing 5-10 spikelets; upper glume apices acute; lemma apices acute..... *Parapholis marginata*
- 3b. Racemes bearing 10-20 spikelets; upper glume apices acuminate; lemmas apices obtuse *Parapholis filiformis*
- 4a. Spikes 1-sided..... 5
- 4b. Spikes 2- or more sided..... 6
- 5a. Raceme not subtended by inflated leaf sheath; spikelets pectinate, solitary..... *Festuca pectinella*
- 5b. Raceme subtended by an inflated leaf sheath; spikelets surrounding the rachis, not pectinately arranged.....
..... *Tetrapogon cenchriformis*
- 6a. Spikelets white-silky villous..... *Lasiurus scindicus*
- 6b. Spikelets green..... 7
- 7a. Raceme subtended by an inflated leaf sheath.....
..... *Elionurus royleanus*
- 7b. Racemes not subtended by an inflated leaf sheath 8
- 8a. Racemes partially enclosed in the sheath
..... *Dichanthium foveolatum*
- 8b. Racemes exerted, not enclosed in the sheath 9
- 9a. Inflorescence open, lax with remote spikelets..... 10
- 9b. Inflorescence dense, narrow with approximate spikelets. 16
- 10a. Lower glumes absent; spikelets rotated 90° edgewise from the culm axis and packed adaxially 11
- 10b. Lower glumes present; spikelets not rotated 90° edgewise from culm axis and packed laterally 14

- 11a. Glumes much longer than the spikelets; lemmas elliptic-ovate, rigid *Lolium temulentum*
- 11b. Glumes shorter than the spikelets; lemmas oblong-lanceolate, not rigid 12
- 12a. Spikelets 11-22-flowered; lemmas awned, at least the upper ones *Lolium multiflorum*
- 12b. Spikelets 3-10-flowered; lemmas unawned, rarely awned 13
- 13a. Perennials; spikelets 2-10-flowered; lemma, if awned, up to 8 mm long; glumes 1/3 to as long as the spikelets *Lolium perenne*
- 13b. Annuals; spikelets 5-8-flowered; lemma, if awned, the awns 3-10 mm long; glumes as long or longer than the spikelets *Lolium rigidum*
- 14a. Rachis fragile, disarticulating at the base of each internode, spikelets falling with attached rachis *Elymus farctus*
- 14b. Rachis not disarticulating at maturity; florets falling separately, the glumes persistent 15
- 15a. Glumes unawned, apex obtuse or mucronate; lemmas unawned; rhizomes absent *Elymus elongatus*
- 15b. Glumes mucronate or short-awned, apex acute; lemmas unawned or short-awned if awned, the awns up to 6 mm long; rhizomes present *Elymus repens*
- 16a. Inflorescence short, rarely over 10 cm long; internodes clavate; spikelets in pairs at each node of thick rachis, pedicelled spikelet sterile and sessile spikelet fertile, deeply sunken in excavated rachis *Hemarthria altissima*
- 16b. Inflorescence long, over 10 cm; internodes not clavate; one to many spikelets borne at a node, not as above and not sunken in an excavated rachis 17
- 17a. Glumes narrowly-linear throughout their length appearing awnlike 18
- 17b. Glumes lanceolate to ovate, wider near the base and not appearing awnlike throughout 19
- 18a. Inflorescence rachis glabrous throughout; lemmas 8-12 mm long, scabrous *Taeniatherum caput-medusae*
- 18b. Inflorescence rachis ciliate along the margins; lemmas 5-7 mm long, villous *Crithopsis delileana*
- 19a. Spikelets in pairs or in groups of 3 at a node 20
- 19b. Spikelets solitary at each node 26
- 20a. Spikelets in pairs, comprising 1 sessile and 1 pedicelled spikelet without rachilla extension; glumes dissimilar; central lemma awned from a sinus; flexuous; 8-22 mm long *Pogonatherum paniceum*
- 20b. Spikelets in group of 3 at each node, lateral spikelets staminate or sterile, central spikelets 1-flowered with bristlelike rachilla extension; glumes similar; central lemma awned from apex, not within a sinus 21
- 21a. Inflorescence rachis tough, not disarticulating at maturity. *Hordeum vulgare*
- 21b. Inflorescence rachis fragile, disarticulating at maturity 22
- 22a. Awns of fertile lemma stout, 4-15 cm long; 2 lateral florets sessile; glumes silky hairy *Hordeum spontaneum*
- 22b. Awns of fertile lemma slender, not more than 3 cm long; 2 lateral florets pedicelled; glumes not silky hairy 23
- 23a. Margin of glumes eciliate; lemma awns 10-24 mm long 24
- 23b. Margin of glumes long ciliate; lemma awns 18- 50 mm long 25
- 24a. One glume of the lateral spikelets expanded below into a broad or narrow wing *Hordeum marinum* subsp. *marinum*
- 24b. Both glumes of the lateral spikelets not expanded below into a broad or narrow wing *Hordeum marinum* subsp. *gussoneanum*
- 25a. Leaf blades green; anthers of central spikelets 0.7-1.4 mm long; prolongation of rachilla of lateral spikelets 3-4 mm long, slender *Hordeum murinum* subsp. *leporinum*
- 25b. Leaf blades glaucous; anthers of central spikelets 0.2-0.5 mm long; prolongation of rachilla of lateral spikelets 1-2 mm, stout *Hordeum murinum* subsp. *glaucum*
- 26a. Glumes rounded over the midveins, lateral veins distinct 27
- 26b. Glumes keeled over the midveins, lateral veins not always distinct 32
- 27a. Spikes moniliform (resembling a string of beads), swollen at base; disarticulating at the base of the spikelet *Aegilops ventricosa*
- 27b. Spikes not moniliform or swollen at base; disarticulating at the base of the internode 28
- 28a. Spikes 10-20 cm long; glumes unawned; only the terminal spikelets with 2 long stout awns *Aegilops longissima*
- 28b. Spikes 1-8 cm long; glumes awned or unawned; terminal spikelet with awns no different than those below 29
- 29a. Spikes 4-8 cm long; glume apex bidentate; principal lemma awns 30-60 mm long *Aegilops bicornis*
- 29b. Spikes 0.5-5 cm long; glumes apex not bidentate; principal lemma awns ≤ 30 mm long 30

- 30a. Glumes with veins unequal in width, unequally spaced and sunk into the surface of the glume
.....*Aegilops geniculata*
- 30b. Glumes with veins equal in width, equally spaced, riblike and protruding from the surface of the glume 31
- 31a. Awns of lower glumes of equal width below and about equal in length; glumes of lowest fertile spikelet always with 3 awns..... *Aegilops kotschyi*
- 31b. Awns of lower glumes of unequal width below and unequal in length; glumes of lowest fertile spikelet with 2 or 3 awns..... *Aegilops peregrina*
- 32a. Lemma awns up to 15 cm long (cultivated wheat) 33
- 32b. Lemma awns 0-7 mm long (wild plants)..... 36
- 33a. Inflorescence rachis fragile, disarticulating at maturity; upper glumes apex emarginate; lemma awns 10-15 cm long..... *Triticum dicoccum*
- 33b. Inflorescence rachis tough, not diarticulating at maturity; upper glumes apex with a unilateral teeth, truncate or 1-awned..... 34
- 34a. Glumes keeled above; winged on keeled; , rounded below; upper glumes apex with a unilateral teeth; truncate or 1-awned, awns 0-40 mm long; lemma awns 0-15 cm long *Triticum aestivum*
- 34b. Glumes keeled from the bases to the apex; upper glumes apex with unilateral teeth, truncate; lemma awns 8-15 cm long..... 35
- 35a. Spikelets with 2-3 fertile florets..... *Triticum durum*
- 35b. Spikelets with 3-5 fertile florets..... *Triticum turgidum*
- 36a. Perennials; racemes tough; anthers 3-5 mm long
..... *Agropyron cristatum*
- 36b. Annuals; racemes fragile; anthers < 1.5 mm long 37
- 37a. Palea at least as long as the body of the lemma; lemma awned, the awns 5-7 mm long; upper glumes awned, the awns 5-7 mm long..... *Eremopyrum distans*
- 37b. Palea shorter than the body of the lemma; lemma unawned or with a short awn, the awns up to 3 mm long; upper glumes unawned..... *Eremopyrum bonaepartis*
- Group 11: Panicles spiciform, narrow usually < 1 cm wide*
- 1a. Panicles silky with the spikelets enveloped in long silky white hairs originating from the callus
..... *Imperata cylindrica*
- 1b. Panicles not silky and callus not long hairy 2
- 2a. Base of glumes dilated forming a bulblike swelling
..... *Gastridium phleoides*
- 2b. Base of glumes not dilated..... 3
- 3a. Panicle branches consisting of clusters each with 3 sterile spikelets ± covering 2 smaller spikelets, one of which is fertile *Lamarckia aurea*
- 3b. Panicle branches not as above..... 4
- 4a. Spikelets awned (lemma and/or glumes) 5
- 4b. Spikelets unawned..... 13
- 5a. Glumes awned 6
- 5b. Glumes unawned; lemmas awned or mucronate..... 9
- 6a. Lemmas awned..... 7
- 6b. Lemmas unawned 8
- 7a. Lower glume mucronate, the mucro 0.5-1 mm long; upper glume awns 1.5-6 mm long; fertile lemma apex entire; sterile lemma awn hooked..... *Holcus annuus*
- 7b. Lower glume awns 3-7 mm long; upper glume awns 4-7 mm long; lemma apex dentate, 4-fid; lemma awns not hooked..... *Polypogon monspeliensis*
- 8a. Lower and upper glumes awns 1-2 mm long
..... *Phleum pratense*
- 8b. Lower and upper glumes awns 3-7 mm long.....
..... *Polypogon maritimus*
- 9a. Lemma apex entire, mucronate or awned, the awns up to 2 mm long..... *Trisetaria koeleroides*
- 9b. Lemmas usually awned, the awns 1-16 mm long..... 10
- 10a. Lemma awns 8-16 mm long, the geniculate awn arising dorsally near the base of the lemma.....
..... *Alopecurus myosuroides*
- 10b. Lemma awns 1-5 mm long; the straight awn arising near or just below the apex of the lemma 11
- 11a. Glumes subequal, the lower minutely longer than the upper and often densely wooly *Rostraria pumila*
- 11b. Glumes unequal, the lower shorter and narrower than the upper, the lower never densely wooly, usually glabrous or with a few scattered hairs 12
- 12a. Panicles oval in outline, bristly; lemma surface setose, the hairs 0.5 mm long; lemma awns 3-5 mm long
..... *Rostraria hispida*
- 12b. Panicles linear or oblong in outline, not bristly; lemma surface not setose; lemma awns 1-3 mm long 13

- 13a. Panicles branches pubescent; lower glumes pubescent; lemma awns subterminal, scabrous.....*Rostraria rohlfsii*
- 13b. Panicles branches glabrous; lower glumes glabrous or pubescent; lemma awns terminal, glabrous.....
.....*Rostraria cristata*
- 14a. Glume keel winged 15
- 14b. Glume keel not winged 20
- 15a. Glume with 2 teethlike projections just above the middle..
.....*Phalaris paradoxa*
- 15b. Glume without 2 teethlike projections just above the middle 16
- 16a. Wings broad, margins erose or denticulate..... 17
- 16b. Wings narrow, margins entire..... 18
- 17a. Perennials; culms with a swollen base or pseudocorm; sterile spikelets surrounding the fertile spikelet; lemmas glabrous or with a few hairs near apex
.....*Phalaris coerulescens*
- 17b. Annuals; culms without a swollen base; sterile spikelets not surrounding the fertile spikelet; lemmas pubescent.....
.....*Phalaris minor*
- 18a. Inflorescence capitate, wider near base; caespitose annuals
.....*Phalaris canariensis*
- 18b. Inflorescence oblong, not wider near base; rhizomatous perennials..... 19
- 19a. Panicles interrupted below; rhizomes long and creeping; ligules 6-10 mm long*Phalaris arundinacea*
- 19b. Panicles not interrupted below; rhizomes short and knotty; ligules 2-4 mm long..... *Phalaris aquatica*
- 20a. Lemmas pilose with tubercle-based hairs, the hairs 4-5 mm long.....*Melica persica*
- 20b. Lemmas not long pilose or with tubercle based. 21
- 21a. Glumes deciduous..... 22
- 21b. Glumes persistent 23
- 22a. Spikelets with 6-12 florets; palea keels pectinate-ciliate, the hairs nearly 1 mm long; ligule a ciliate membrane; lemma apex obtuse *Eragrostis ciliaris*
- 22b. Spikelets with 1 floret; palea keels not pectinate-ciliate; ligule a line of hairs; lemma apex acute.....
.....*Sporobolus spicatus*
- 23a. Lemma surface pubescent with clavate hairs; lemma apex truncate *Phleum subulatum*
- 23b. Lemma surface glabrous or pubescent but without clavate hairs; lemma apex acute or obtuse 24
- 24a. Culms 60-150 cm tall, erect and reedlike; spikelets 10-16 mm long; panicles 7-22 cm long*Calamagrostis arenaria*
- 24b. Culms 5-50 cm tall, decumbent, geniculate or mat-forming; spikelets 2-7 mm long; panicles 1-7.5 cm long..... 25
- 25a. Spikelets 1-flowered, 2-2.5 mm long; lemmas 1-veined, 2-2.5 mm long; glumes shorter than the florets
.....*Sporobolus alopecuroides*
- 25b. Spikelets 3-5-flowered, 3-7 mm long; lemmas 5-veined, about 4 mm long; glumes slightly longer than the florets..
..... *Rostraria obtusiflora*
- Group 12: Panicles contracted, 0.5-3 (-4) cm wide*
- 1a. Upper and/or lower glumes awned 2
- 1b. All glumes unawned..... 3
- 2a. Lower glume awned, the awns 3-5 mm long; upper glume awns 7-8 mm long; lemmas 6-7 mm long; spikelets 7-10 mm long..... *Festuca brevis*
- 2b. Lower glume unawned; upper glume awns 4-6 mm long; lemmas 8-18 mm long; spikelets 12-16 mm long.....
..... *Festuca fasciculata*
- 3a. Principal lemmas awned 4
- 3b. Principal lemmas unawned 9
- 4a. Lemmas hairy between the veins with 2-8 transverse rows of hair tufts; lemma awns 3-5 mm long..... 5
- 4b. Lemmas not hairy between veins or with transverse rows of hair tufts; awns 5-15 mm long 6
- 5a. Culms 50-120 cm tall, robust; panicles 17-35 cm long; anthers 1.6-2.7 mm long..... *Centropodia fragilis*
- 5b. Culms 10-50 cm tall, smaller; panicles 2-15 (-20) cm long; anthers 0.7-1.3 mm long.....*Centropodia forskalii*
- 6a. Lemma apex bidentate *Bromus fasciculatus*
- 6b. Lemmas apex entire..... 7
- 7a. Panicles curved or nodding..... *Festuca myuros*
- 7b. Panicles straight, not curved or nodding..... 8
- 8a. Lemmas awns 5-12 mm long; callus rounded, about 0.2 mm long; glumes similar *Festuca bromoides*
- 8b. Lemma awns 15-25 mm long; callus pointed, 0.5-0.8 mm long; glumes dissimilar *Festuca fasciculata*
- 9a. Spikelets 1-flowered..... 10
- 9b. Spikelets 3-10-flowered..... 13

- 10a. Lemmas 1-veined; ligule a line of hairs; glumes as long or shorter than the floret 11
limb, brownish, with a ring of hairs at the junction
..... *Corynophorus divaricatus*
- 10b. Lemmas 3 or 5-veined; ligule membranous; glumes longer than the floret 12
- 11a. Leaf blades stiff and pungent, conspicuously distichous; glumes ½ to as long as the floret; lower glume apex acute. *Sporobolus pungens*
- 11b. Leaf blades not stiff, pungent or distichous; glumes <1/4 as long as the floret; lower glume apex obtuse
..... *Sporobolus natalensis*
- 12a. Glumes shiny and glabrous, scaberulous only along the keel; lemmas 1.5-2.3 mm long, apex obtuse; anthers 1-1.5 mm long *Agrostis stolonifera*
- 12b. Glumes scabrous throughout, roughened and not shiny; lemmas 1-1.5 mm long, apex truncate; anthers 0.5-0.8 mm long *Polypogon viridis*
- 13a. Lemmas 3-veined, 1.4-1.5 mm long, membranous, apex acute; glumes deciduous *Eragrostis sarmentosa*
- 13b. Lemmas 5-7-veined, 2-7.5 mm long, coriaceous, apex obtuse or truncate; glumes persistent 14
- 14a. Spikelets with 3-10 fertile florets, if sterile florets present these located above the fertile ones; lemmas 2-2.5 mm long, apex obtuse; stamens 3; anthers about 0.3 mm long. *Catapodium rigidum*
- 14b. Spikelets with a single upper fertile floret and two basal sterile florets; lemmas 3.5-7.5 mm long, apex truncate; stamens 6; anthers 3-4 mm long *Ehrharta calycina*
- Group 13: Spikelets awned; panicles open*
- 1a. Lemma awns (8-)10-30 cm long, feathery 2
- 1b. Lemma awns much shorter, usually < 5 cm long, glabrous or scabrous 5
- 2a. Awns conspicuously twisted together with adjacent spikelet awns forming a tail; annuals *Stipellula capensis*
- 2b. Awns not conspicuously twisted together with others and not forming a tail; perennials 3
- 3a. Awns plumose for their whole length, the hairs 0.5-1.3 mm long *Stipa arabica*
- 3b. Awns scabrid or pubescent, the hairs < 0.3 mm long 4
- 4a. Awns 20-25 cm long, pubescent *Stipa lagascae*
- 4b. Awns 6-13 cm long, scabrous *Stipellula parviflora*
- 5a. Spikelets usually flushed with purple; awns of lemmas inserted from the base, the column with a clavate upper limb, brownish, with a ring of hairs at the junction
..... *Corynophorus divaricatus*
- 5b. Spikelets green; awns of lemmas subapical or inserted near the middle, the column never clavate or with a ring of hairs at the junction 6
- 6a. Spikelets all solitary. 7
- 6b. Spikelets in pairs usually with a sessile and pedicellate or in triplets with two pedicellate and one sessile 30
- 7a. Spikelets (10-) 15-60 mm long 8
- 7b. Spikelets 1.5-12 mm long 36
- 8a. Glumes longer than the spikelet; lemma awns geniculate with a strongly twisted column; ovaries pubescent all over 9
- 8b. Glumes much shorter than the spikelet; lemma awns usually straight and not geniculate; ovaries pubescent only near the apex 15
- 9a. Tips of lemmas bidentate with awned teeth, the teeth awns usually 1-1.5 cm long 10
- 9b. Tips of lemmas bidentate with unawned teeth or with the awns of the teeth much shorter than 0.8 mm long 12
- 10a. Spikelets erect; callus elongated, 4.2-6 mm long; lower glumes 25-40 mm long *Avena longiglumis*
- 10b. Spikelets pendulous; callus obtuse, < 2 mm long; lower glumes 16-26 mm long 11
- 11a. Spikelets (1.8-) 2-3 cm long; lower lemma 1.6-2 cm long. *Avena barbata* subsp. *barbata*
- 11b. Spikelets 1.4-1.8 cm long; lower lemma 1.2-1.4 cm long ...
..... *Avena barbata* subsp. *wiestii*
- 12a. Floret callus glabrous; lemmas glabrous *Avena sativa*
- 12b. Floret callus hairy; lemmas hairy on the lower 1/3 13
- 13a. Lemmas dark brown; rachilla not disarticulating at maturity *Avena fatua*
- 13b. Lemmas green; rachilla disarticulating between the florets at maturity 14
- 14a. Glumes 30-50 mm long; lowest lemmas 25-40 mm long
..... *Avena sterilis* subsp. *sterilis*
- 14b. Glumes 25-30 mm long; lowest lemmas 20-25 mm long
..... *Avena sterilis* subsp. *ludoviciana*
- 15a. Spikelets 45-60 mm long; lemmas awns 45-60 mm long
..... 16
- 15b. Spikelets less than 45 mm long; lemmas awns 4-40 mm long 17

- 16a. Panicles lax, spreading, broadly ovate, the branches longer than spikelets; base of lemmas in profile, contracted just above the callus; callus blunt with an oval scar
..... *Bromus diandrus* var. *diandrus*
- 16b. Panicles contracted, stiffly erect, narrowly ovate, the branches usually shorter than the spikelets; base of lemmas in profile, continuous with callus; callus pointed with an elliptic scar*Bromus diandrus* var. *rigidus*
- 17a. Lower glumes 1-veined; upper glumes 3-veined; lemma awns not more than 20 mm long..... 18
- 17b. Lower glumes 3-9-veined; upper glumes 5-13-veined; awns usually 15-40 mm long 21
- 18a. Panicles branches compound bearing (3-) 5-8 fertile spikelets.....*Bromus tectorum* var. *tectorum*
- 18b. Panicles branches simple bearing 1-3 fertile spikelets 19
- 19a. Panicles branches bearing 1-3 fertile spikelets; spikelet pedicels \leq 1 cm long; lemmas 10-20 mm long..... 20
- 19b. Panicles branches bearing a single fertile spikelet; spikelet pedicels usually $>$ 3 cm long; lemmas 15-40 mm long.....
..... *Bromus sterilis*
- 20a. Plants perennial and rhizomatous; lemmas awnless, mucronate or short-awned, the awns up to 1.5 mm long ..
..... *Bromus inermis*
- 20b. Plants annuals, caespitose; lemmas awned, the awns 12-20 mm long..... *Bromus madritensis*
- 21a. Lemma awns curved and reflexed-spreading..... 22
- 21b. Lemma awns straight 23
- 22a. Lemmas coriaceous with inconspicuous veins; margins of lemma not involute but overlapping the back of the adjacent lemma; ligules 1-3 mm long*Bromus japonicus*
- 22b. Lemmas membranous with conspicuous veins; margins of lemma somewhat involute at maturity, not overlapping the back of the adjacent lemma but wrapped around the caryopsis; ligules 3-6 mm long *Bromus pulchellus*
- 23a. Lemma awns briefly coiled at the base 24
- 23b. Lemmas awns not coiled at the base 26
- 24a. Spikelets 10-15 mm long, 2-3 mm wide; lemmas 6-11 mm long..... *Bromus scoparius*
- 24b. Spikelets (12-) 25-50 mm long, 3-16 mm wide, lemmas 11-18 mm long..... 25
- 25a. Leaf blades 3-5 mm wide; lemma awns 11-20 mm long; spikelets 3-7 mm wide..... *Bromus alopecuroides*
- 25b. Leaf blades 1-2.5 mm wide; lemma awns 6-12 mm long; spikelets 6-16 mm wide *Bromus lanceolatus*
- 26a. Lemmas strongly keeled; spikelets strongly laterally compressed..... *Bromus catharticus*
- 26b. Lemmas rounded on the back; spikelets terete to moderately laterally compressed 27
- 27a. Glumes with ciliolate margins; culms nodes swollen.....
..... *Bromus aegyptiacus*
- 27b. Glumes without ciliolate margins; culm nodes not swollen 28
- 28a. Lemmas 5.5-6.5 mm long; lemma awns 3-7 mm long, terete near base, straight; caryopsis longer than the palea, often visible beyond the tip of the lemma.. *Bromus lepidus*
- 28b. Lemmas 8-17 mm long; lemma awns 5-17 mm long, flattened near base, straight or slightly divergent; caryopsis shorter than the palea, concealed within the floret..... 29
- 29a. Lemmas 5-7-veined, 2-4 mm wide, glabrous or pubescent, narrowly lanceolate in profile; lemma awn arising 2-3 mm below the tip; anthers 1 mm long; lower glumes usually 3-veined*Bromus pectinatus*
- 29b. Lemmas 7-9 (-11)-veined, 4.5-5.5 mm wide, hirsute, narrowly oblanceolate in profile; lemma awn arising 0.7-1.9 mm below the tip; anthers 2-2.5 mm long; lower glumes 3-7-veined..... *Bromus hordeaceus*
- 30a. Spikelets in triplets with two pedicellate and one sessile 31
- 30b. Spikelets in pairs, fertile spikelets sessile and sterile spikelets pedicelled 32
- 31a. Panicles branches villous with white or dark brown hairs; fertile lemmas glabrous without transverse tufts of hairs; leaf blade apices not stiff and pungent, margins not white cartilaginous; upper glume of fertile lemma plumose
..... *Chrysopogon plumulosus*
- 31b. Panicle branches scaberulous without white or dark brown hairs; fertile lemmas with transverse tufts of hairs, the hairs 4-5 mm long; leaf blade apices stiff and pungent with conspicuous white cartilaginous margins; upper glume of fertile lemma unawned*Danthoniopsis barbata*
- 32a. Column of the lemma awns pubescent, hairy on the spiral; paleas present 33
- 32b. Column of the lemma awns glabrous, not hairy on the spiral; paleas absent or minute..... 34
- 33a. Apex of lower glume dentate, 3-fid; awns of upper lemma 10-16 mm long; plants perennial, rhizomatous
.....*Sorghum halepense*
- 33b. Apex of lower glume entire; awns of upper lemma up to 10 mm long; plants annual or short-lived perennials, not rhizomatous *Sorghum bicolor*
- 34a. Lower glumes pubescent with white or yellow hairs.....
..... *Sorghum arundinaceum*

- 34b. Lower glumes glabrous..... 35
- 35a. Panicle branches tough; spikelet callus pilose.....
..... *Sorghum x drummondii*
- 35b. Panicle branches fragile at node; spikelet callus not pilose.
.....*Sorghum virgatum*
- 36a. Glumes and lemmas villous with white or purplish-red
hairs..... 37
- 36b. Glumes and lemmas glabrous 37
- 37a. Spikelets 1.5–2 (–2.4) mm long; upper glumes not gib-
bous *Melinis minutiflora*
- 37b. Spikelets 5–12 mm long; upper glumes gibbous.....
.....*Melinis repens*
- 32a. Lemmas 1.5–2 mm long, the awns 3–5 mm long; apex of
lemma obtuse *Oloptum miliaceum*
- 32b. Lemmas 6–7.5 mm long, the awns 8–13 mm long, apex of
lemma acute.....*Piptatherum holciforme*
- Group 14: Spikelets unawned; panicles open*
- 1a. Both glumes absent or obscure..... 2
- 1b. Both glumes or at least the upper present..... 3
- 2a. Spikelets 8–11 mm long, 2.5–3.5 mm wide, persistent;
lemma apex mucronate or awned, the awns up to 160
(cult.)..... *Oryza sativa*
- 2b. Spikelets 3.4–4.8 (–5.2) mm long, 1.2–1.4 (–1.7) mm
wide, disarticulating entire; lemma apex entire, not
mucronate or awned.....*Leersia hexandra*
- 3a. Primary panicles branches whorled, at least on the lower
nodes 4
- 3b. Primary panicles branches not whorled at most nodes.. 10
- 4a. Lemmas pubescent, hairy below and along the veins..... 5
- 4b. Lemmas glabrous throughout 6
- 5a. Lemma apex apiculate; anthers 1.4–2.6 mm long.....
..... *Poa diaphora*
- 5b. Lemma apex not apiculate; anthers 0.3–0.7 (–1) mm long..
.....*Poa persica*
- 6a. Glumes longer than the florets, persistent..... 7
- 6b. Glumes \leq the florets, deciduous or persistent..... 8
- 7a. Roots aromatic; lower glumes surface spinose, glumes dis-
similar; spikelets 3.5–5 mm long.....
..... *Chrysopogon zizanioides*
- 7b. Roots not aromatic; lower glumes surface not spinose,
glumes similar; spikelets 1.8–3 mm long
.....*Agrostis stolonifera*
- 8a. Spikelets dorsally compressed with a 5-veined sterile
lemma just below the fertile lemma; leaf blades usually
12–35 mm wide *Megathyrsus maximus*
- 8b. Spikelets laterally compressed without a sterile lemma
below the fertile lemma, the fertile lemma 1-veined; leaf
blades 1–10 mm wide 9
- 9a. Panicles 3–20 cm long; apex of lower glumes obtuse;
anthers 0.7–1 mm long.....*Sporobolus ioclados*
- 9b. Panicles 20–60 cm long; apex of lower glumes acute;
anther 1.1–1.3 mm long *Sporobolus wrightii*
- 10a. Spikelets pendulous; lemmas orbicular, gibbous, and
auriculate near base..... 11
- 10b. Spikelets not pendulous; lemmas not orbicular. gibbous or
auriculate near base..... 12
- 11a. Spikelets 3–5 mm long, 3–5 mm wide; apex of lemma not
cuspidate*Briza minor*
- 11b. Spikelets 14–25 mm long, 8–15 mm wide; apex of lemma
cuspidate*Briza maxima*
- 12a. Spikelets in pairs with a fertile sessile and sterile pedi-
celled..... *Sorghum bicolor*
- 12b. Spikelets not in pairs 13
- 13a. Lemmas with white capitate hairs near base, the hairs 0.2
mm long.....*Desmazeria philistaea*
- 13b. Lemmas without white capitate hairs..... 14
- 14a. Glumes and lemmas pilose with white tubercle-based
hairs *Tricholaena teneriffae*
- 14b. Glumes and lemmas not pilose or, if hairy, the hairs not
white and tubercle-based 15
- 15a. Lemma apex bifid and dentate..... 16
- 15b. Lemmas apex not bifid or dentate. 19
- 16a. Spikelets 15–25 mm long; lemmas 10–13 mm long; ovary
pubescent on the apex; rhizomatous perennials.....
..... *Bromus inermis*
- 16b. Spikelets \leq 7 mm long; lemmas 1.2–3.3 mm long; ovary
glabrous throughout; caespitose annuals or perennials .. 17
- 17a. Spikelets 1.5–2.4 mm long, persistent; lower glumes with-
out veins.....*Melinis minutiflora*
- 17b. Spikelets 4–7 mm long, deciduous with the pedicels; lower
glumes 5–7-veined 18
- 18a. Lemmas 2–3.5 mm long, apical lobes narrowly triangular,

- 0.6-1.3 mm long; palea shorter than the lemma
 *Schismus arabicus* 50-150 cm tall; leaf blades 4-10 mm wide
 *Lolium arundinaceum*
- 18b. Lemmas 1.5-2 mm long, apical lobes broadly triangular,
 0.3-0.4 mm long; palea \geq the lemma in length
 *Schismus barbatus*
- 19a. Spikelets all 1-flowered with no additional florets
 *Sporobolus wrightii*
- 19b. Spikelets with more than a single floret 20
- 20a. Spikelets with one fertile floret and 1 or 2 sterile florets
 21
- 20b. Spikelets with 3-10 fertile florets 28
- 21a. Spikelets laterally compressed, each spikelet with 2 basal
 sterile florets; fertile florets with 6 stamens
 *Ehrharta calycina*
- 21b. Spikelets dorsally compressed, each spikelet with 1 basal
 sterile floret; fertile florets with 3 stamens 22
- 22a. Upper fertile lemma faintly to strongly rugose
 *Megathyrsus maximus*
- 22b. Upper fertile lemma smooth 23
- 23a. Spikelets 3.5-5.5 mm long 24
- 23b. Spikelets 2-3.2 (-3.5) mm long 25
- 24a. Plants annual without woody culms or resembling bushes;
 leaf blade apices not pungent *Panicum miliaceum*
- 24b. Plants perennial with woody culms resembling bushes;
 leaf blade apices pungent *Panicum turgidum*
- 25a. Lower glumes $\frac{1}{2}$ - $\frac{2}{3}$ the length of the spikelet; lemmas
 apex acute *Panicum antidotale*
- 25b. Lower glumes up to $\frac{1}{3}$ the length of the spikelet 26
- 26a. Plants with a knotty rootstock; lower glume membranous,
 1-3 (-7)-veined *Panicum coloratum*
- 26b. Plants without a knotty rootstock but with slender rhi-
 zomes or stolons; lower glumes hyaline, usually unveined,
 rarely 3-veined 27
- 27a. Plants erect with spreading rhizomes; leaf sheaths tough,
 wooly on the margins when young; leaf blade apices pun-
 gent; ligules 0.3-0.5 mm long *Panicum repens*
- 27b. Plants with stolons; leaf sheaths loose, papery, glabrous on
 the margins; leaf blade apices not pungent; ligules 0.8-2
 mm long *Panicum hygrocharis*
- 28a. Lemmas 5-veined 29
- 28b. Lemmas 3-veined 32
- 29a. Spikelets 10-18 mm long; lemmas 6-9 mm long; culms
- 29b. Spikelets 2-10 mm long; lemmas 2-5 mm long; culms \leq
 65 cm tall; leaf blades 1-5 mm wide 30
- 30a. Plants perennial forming a bulbous base composed of old
 leaf sheaths; anthers 1.5-2.5 mm long; apex of ligule acute
 *Poa sinaica*
- 30b. Plants annual or short-lived perennials, not forming a
 bulbous base of old leaf sheaths; anthers \leq 1.1 mm long;
 apex of ligule obtuse 31
- 31a. Anthers 0.6-1 (-1.1) mm long; spikelets crowded or
 sparsely arranged on the branches *Poa infirma*
- 31b. Anthers 0.1-0.5 mm long; spikelets always crowded on
 the branches *Poa annua*
- 32a. Plants perennial, forming innovations at the basal nodes;
 caryopses narrowly triangular in cross section, strongly
 laterally flattened with a deep ventral groove
 *Eragrostis tenuifolia*
- 32b. Plants annual, usually tufted, without innovations at the
 basal nodes; caryopses not narrowly triangular in cross
 section or strongly laterally flattened, without a deep ven-
 tral groove 33
- 33a. Palea keels prominently ciliate, the cilia 0.2-1 mm long 34
- 33b. Palea keels smooth or scabrous the scabridities $<$ 0.2 mm
 long 35
- 34a. Spikelets 2.2-3 mm long; lemmas and culms without
 glands; lemmas (0.8-) 1-1.2 mm long, oblong; anthers 2...
 *Eragrostis lepida*
- 34b. Spikelets 6-20 mm long; lemmas with crateriform glands
 on the keels, similar glands also often present below the
 nodes; lemmas 2-2.8 mm long, broadly ovate; anthers 3 ...
 *Eragrostis cilianensis*
- 35a. Ligules membranous, neither ciliolate or ciliate
 *Eragrostis japonica*
- 35b. Ligules membranous and ciliolate to ciliate, the cilia often
 longer than the basal membrane 36
- 36a. Plants with glandular pits or bands somewhere, the loca-
 tions various, including any or all of the following: below
 the cauline nodes, on the sheaths, blades, rachises, panicle
 branches or pedicels, or on the keels of the lemmas and
 paleas 37
- 36b. Plants without glandular pits or bands 40
- 37a. Spikelets 1-1.4 mm wide; pedicels 1-10 mm long, lax
 appressed or divergent *Eragrostis pilosa*
- 37b. Spikelets 1.1-4 mm wide; pedicels 0.2-4 mm long, stiff,
 straight, usually divergent 38

- 38a. Lemmas 2-2.8 mm long with 1-3 crateriform glands along the keels; spikelets 6-20 mm long, 2-4 mm wide, with 10-40 florets; disarticulation below the florets, the rachillas persistent; anthers yellow*Eragrostis cilianensis*
- 38a. Lemmas 1.4-1.8 mm long, rarely with 1 or 2 crateriform glands along the keels; spikelets 4-7 (-11) mm long, 1.1-2.2 mm wide, with 7-12 (-20) florets; disarticulation below the lemmas, both the paleas and rachillas usually persistent; anthers reddish-brown 39
- 39a. Panicles with glandular regions below the nodes, the glandular tissue forming a ring or band, often shiny or yellowish; blade margins without crateriform glands; pedicels without glandular bands*Eragrostis barrelieri*
- 39b. Panicles sometimes with glandular areas, but rarely rings of glandular spots or crateriform pits below the nodes, the glands usually dull greenish-gray to stramineous; blade margins sometimes with crateriform glands; pedicels usually with glandular bands..... *Eragrostis minor*
- 40a. Lemmas 1.6-3 mm long; florets persistent and the grain retained within; caryopses 0.3-1.3 mm long obovoid, smooth, light brown to white; plants cultivated, occasionally escaping..... *Eragrostis tef*
- 40b. Lemmas 1.2-1.7 mm long; florets deciduous, the grains not retained within; caryopses 0.4-0.9 mm long, ovoid, orbicular to prism-shaped or isodiametric, smooth or striate, brownish; plants native or established introductions 41
- 41a. Spikelets 5-25 mm long, 10-60-flowered; anthers 2.....
..... *Eragrostis tremula*
- 41b. Spikelets 3-15 mm long, 4-20 flowered; anthers 3 42
- 42a. Lower glumes 1-1.5 mm long, about as long as the upper glume, 1-veined; panicle branches not whorled at the lower nodes; lemma apex truncate or obtuse; caryopses orbicular, isodiametric *Eragrostis aspera*
- 42b. Lower glumes 0.5-0.7 mm long, ½ to 2/3 as long as the upper glume, unveined; panicle branches whorled at the lower nodes; lemma apex acute or obtuse caryopses ellipsoid 43
- 43a. Panicle branches partially included below in the subtending leaf; spikelets 5-15 cm long; caryopses 0.5-0.7 mm long *Eragrostis aegyptiaca*
- 43b. Panicle branches exserted and not included below in the subtending leaf; spikelets 3-6 mm long; caryopses 0.7-1 mm long*Eragrostis pilosa*

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