The wild fodder Sorghums of the section Eu-Sorghum.

By J. D. SNOWDEN, F.L.S., Economic Botanist (Retired), Uganda.

(With 20 Text-figures)

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HISTORY AND CLASSIFICATION

Sorghums have been cultivated for their grains or sweet stems since ancient times, but little attention was given to the small-grained wild Sorghums until the beginning of the twentieth century when some of them were introduced into the United States of America, where they soon became popular and were extensively cultivated as fodder for stock. Linnaeus, in the first edition of his *Species Plantarum*, published in 1753, included the Sorghums known to him under the genus *Holcus*, and described the wild race he knew as *H. halepensis*. The same species was referred to by Scopoli (*Flora Carniolica*, ed. 2, **2**, 274, 1772) under *Andropogon arundinaceus*. Later, when the *Holcus* of Linnaeus was divided into several genera, the Sorghums were transferred to the genus *Sorghum* by Moench (in *Methodus Plantas*, p. 207, 1794); and Persoon (in his *Synopsis Plantarum*, **1**, 101, 1805), the latter referring the wild Sorghums to *S. halepense*. Brotero, however (in *Fl. Lusitanica*, **1**, 89, 1804), placed the Sorghums in the genus *Andropogon* and made the combination *A. halepensis* for the wild species. In his Monograph of the Andropogoneae Hackel (in De Candolle's *Monographiae Phanerogamarum*, **6**, 499, 502, 1889) classified all the races of *Sorghum* under *Andropogon sorghum*, placing the cultivated species under the subspecies *sativus* and the wild ones under the subspecies *halepensis*.

It was suggested, by Hackel, in 'Die kultivirten Sorghum-Formen und ihre Abstammung' (in Engl., *Bot. Jahrb.* **7**, 115–26, 1885), and Koernicke (in *Handbuch des Getreidebaues*, **1**, 300, 1885), that the cultivated Sorghums had been derived from varieties of *A. halepensis*. This led some botanists to infer that all the cultivated varieties had been derived from one wild ancestor. Piper, who had studied many of the Sorghums under cultivation in the United States, as well as the herbarium material in that country, at Kew, and in Berlin, in his revision of *A. halepensis* and *A. sorghum* (in *Proc. Biol. Soc. Wash.* **28**, 25–44, 1915) pointed out that Hackel had indicated that they had arisen from those varieties without perennial rootstocks, such as *effusus*, *virgatus*, and *aethiopicus*, and not from those having original rhizomes. Piper then classified the wild races of the former under eleven subspecies of *A. sorghum*, and placed those with rhizomes under six subspecies of *A. halepensis*.

In his revision of the African Sorghums Stapf (in Prain, *Fl. Trop. Afr.* **9**, 104–54, 1917) decided to retain *Sorghum* as a separate genus. He discussed the classifications of Hackel, Koernicke and Piper, pointed out the desirability of recognizing smaller units, and described all the wild and cultivated species of Tropical Africa known to him. He divided them into two sections, namely *Eu-Sorghum*, containing twenty-seven species, where among the wild Sorghums many of Piper's subspecies were given specific rank, and *Sorghastrum*, in which he placed six species of a distinctive group that Nash (in Britton, *Manual of the Flora of the Northern States and Canada*, p. 71, 1901) had described as a new genus under the name of *Sorghastrum*.

In my 'Classification of the Cultivated Sorghums' (in *Kew Bull.* pp. 222, 223, 1935) I decided to keep *Sorghastrum* Nash separate from *Sorghum*, as the plants of this group differ from the true Sorghums, especially in the solitary primary branches of the panicle, which are often much branched quite near the base so that they appear to be falsely semi-verticillate; the pedicelled spikelets usually reduced to the hairy pedicels; and the glabrous lodicules. The lower glume is also usually shorter than the upper. The separation

of *Sorghastrum* left a more uniform genus *Sorghum* which was divided into two sections, characterized as follows:

I. *Eu-Sorghum:* sheath-nodes glabrous or finely pubescent, not bearded; primary branches of the panicle divided (at least the lower); racemes lateral and terminal; number of chromosomes (in those species that have been examined) $2n=20$, or $2n=40$.

A. Subsection *Arundinacea*: annuals, or tufted perennials without rhizomes; number of chromosomes usually $2n=20$ (rarely $2n=40$). This subsection is divided into two series, *Spontanea*, containing the wild Sorghums, and *Sativa*, embracing the cultivated Sorghums.

B. Subsection *Halepensia*: perennials possessing distinct elongated rhizomes; number of chromosomes usually $2n=40$; wild Sorghums.

II. *Para-Sorghum*: sheath-nodes bearded (at least the upper); primary branches of the panicle simple; racemes terminal; number of chromosomes $2n=10$; wild Sorghums.

An account of the cytological work carried out by Garber (in *Amer. Nat.*, **78**,89–94, 1944) supports the separation of *Para-Sorghum* as a distinct section and tends to confirm that the Sorghums of this group are unlikely to have been concerned in the evolution of the cultivated Sorghums. Most of the species of this group are slender grasses with little bulk and, as they do not appear to have any special importance as fodder for stock, they are not dealt with further in this account of the Arundinaceous Forage Sorghums.

The wild Sorghums of the two subsections of *Eu-Sorghum* are very similar in most characters, but those of the *Halepensia* group, besides possessing rhizomes and usually having a higher number of chromosomes, generally show little tendency to hybridize with the cultivated grain Sorghums. They also have a different area of distribution, which extends from the Mediterranean region eastwards to India and south-western Asia. On the other hand, the wild Sorghums of the series *Spontanea* and the cultivated races of the series *Sativa*, which belong to the subsection *Arundinacea*, are frequently found to hybridize with one another in regions where Sorghums are grown for their grains and sweet stems, and the wild races of this subsection are mainly distributed in tropical and subtropical Africa.

The relationships of the wild and cultivated Sorghums were reviewed in my account of the 'Grain and Sweet-stemmed Sorghums' (*The Cultivated Races of Sorghum*, pp. 234–40, 1936). A few of the more important intermediate races that appear to have arisen naturally, and not as a direct result of artificial cross-fertilization, are included below, together with the other wild races of the section *Eu-Sorghum*. Although they generally agree with the wild Sorghums in possessing small grains enclosed by the glumes, they have somewhat tougher racemes resembling those of the cultivated races. Those cultivated Sorghums that show signs of degeneration as a result of intercrossing with wild species, generally indicated by the racemes shattering and the spikelets readily falling, will be excluded from this revision. In connexion with the cross-pollination that occurs between the different races of Sorghum, it is of interest to record that in India, in the course of experiments undertaken to procure early-maturing races of sugar cane, by means of artificial cross-fertilization, hybrids between *Sorghum* and *Saccharum* have been raised, thus indicating the possibility of a closer relationship between these two genera than has generally been accepted.

As so many specimens of wild Sorghums have been received at Kew since Dr Stapf's account of the Tropical African species was published in 1917, a revision of those belonging to the section *Eu-Sorghum* has now become practicable and indeed has been found necessary in order to facilitate the identification of the material, especially that received from North-east, Central, and East Africa. In dealing with these Sorghums, however, it should be noted that the descriptions of the species and varieties are based on the dry herbarium specimens, although amplified in some cases by information from collectors' notes.

GENERAL CHARACTERS OF THE WILD SPECIES OF SECTION *EU-SORGHUM*

Annual or perennial grasses one to several metres high. *Culms* slender to stout, usually terete, often woody and reed-like, few to many noded, simple or sometimes branched above, usually glabrous and green but often with purplish markings and a grey waxy bloom. *Leaves* alternate; sheaths usually clasping the culms when young, often shorter than the mature internodes, generally glabrous except for a little pubescence near the base, along the margins and near the junction with the blade; ligule usually a membranous or scarious rim 1–3 mm. long, ciliate from the back; blades convolute in bud but soon becoming flat, usually linear to linear-lanceolate, narrowing upwards to an acuminate tip, glabrous except for a few hairs near the ligule and the junction with the sheath, mostly light to dark green with a paler, often broad and pronounced, mid rib, sometimes with purplish markings, generally spinulously scabrid on the margins, especially upwards.

Panicles usually compound or decompound, varying much in shape and size, generally loose and open on erect peduncles, at length more or less exserted from the uppermost leaf-sheath; rhachis usually continuous, often striate or channelled, with the angles spinulously ciliate, at least upwards; branches 1–6 (rarely more) from a node, usually hairy at the base and also in the angles of the divisions, often scabrid. *Racemes* terminal and lateral on the branchlets, which may arise from near the base, or 1–5 cm. or more from the base, of the branches, 1- to 7-noded (rarely more), mostly fragile and generally readily disarticulating at maturity, but sometimes rather tough; internodes (joints) and pedicels very similar, but the internodes often more dorsally compressed and almost flat on the face, slender to filiform, ciliate along the sides, the pedicels generally with almost discoid or sometimes oval tips; spikelets mostly in pairs composed of one sessile and one pedicelled, except at the end of each raceme where there is usually one sessile and two pedicelled spikelets.

Sessile spikelets dorsally compressed, varying in shape, mostly awned but sometimes awnless, with a small blunt, usually bearded, callus at the base of the lower glume; florets 2, the lower floret usually reduced to its lemma. *Glumes* equal or almost equal in length, usually coriaceous for the most part but thinner towards the tips and with a thin transverse basal strip 0·3–0·5 mm. wide, rarely thinner and subcoriaceous to papery or crustaceous throughout, the margins papery to membranous, narrowly incurved, those of the lower clasping the upper (except when in flower), so that when closed they more or less conform to the shape of the spikelet in outline; lower glume flattened or only slightly convex on the back, mostly 10- to 15-nerved, but usually with only 3–5 nerves outwardly evident near the tip, generally with short cross-nerves scattered in the middle third or three-fifths, the margins narrowly inflexed upwards, 2-keeled from about the middle or in the upper third or fourth, with the scarious spinulously ciliolate keels usually narrowly winged (marginate) and terminating in minute teeth just below the hyaline apex, or sometimes gradually merging imperceptibly with it; upper glume convexly boat-shaped, usually 7-nerved (rarely more), the central nerve finely keeled and scaberulous above the middle or near the tip, short cross-nerves usually present in the middle third or three-fifths, the incurved margins hyaline and usually finely long-ciliate, at least upwards. *Lemmas* hyaline, thinly membranous and often very fragile, the margins incurved and usually finely ciliate; lower lemma (when flattened out, as in the following descriptions) almost similar in shape and size to the lower glume but a little shorter and with the apex obtuse or slightly notched, usually with two fine nerves, one on each side, but sometimes with a third central nerve; upper lemma usually 1–2 mm. shorter than the lower, ovate to ovate-elliptic, finely 1- to 3-nerved, the two lateral often short or obscure, the apex 2-lobed and with an awn from the sinus, or sometimes entire, or almost entire, and then muticous or mucronate; awn usually abruptly bent near the middle, the lower half tightly twisted to form a straight stem or column and glabrous or finely pubescent along the spirals, the upper part or bristle being only slightly twisted

and finely scaberulous along the margins. *Palea* like the lemmas in texture, generally a little shorter than the upper lemma, almost linear to linear-lanceolate, nerveless, with the margins finely, and usually sparsely, ciliate. *Lodicules* 2, somewhat wedge-shaped, about 1–2 mm. long, usually ciliate, but the cilia sometimes reduced to a few or one at each corner. *Stamens* 3, anthers linear, usually yellow. *Styles* 2, terminal or subterminal, with the plumose stigmas sometimes purplish and usually laterally exserted for pollination. *Ovary* glabrous. *Grains* (caryopses) elliptic, obovate-elliptic, or obovate, generally not exceeding half the length of the glumes when mature, more or less dorsally compressed, with the hilum face almost flat and the embryo face convex, the embryo-mark oval and usually about half, or rather more than half, the length of the grain.

Pedicelled spikelets mostly linear-lanceolate to subulate, often much narrower than the sessile, but sometimes little different in size, usually awnless, the upper floret ♂ or sometimes reduced to the lemma like the lower; glumes thinner than those of the sessile spikelets, herbaceous to membranous, with the nerves usually plainly visible throughout their length, otherwise much like those of the sessile in shape and nervation; lemmas like those of the sessile in texture, shape, and nervation, but often reduced in size and the upper usually muticous; palea small or often absent; lodicules like those of the sessile spikelets when present, but smaller and often almost glabrous; anthers mostly smaller than those of the sessile spikelets, but similar in shape and colour.

THE POISONOUS PROPERTIES OF SORGHUM

Cases of Sorghum poisoning or cyanogenesis, resulting from the presence of hydrocyanic or prussic acid in plants used for fodder, have been reported from many countries during the last fifty years. The toxicity varies not only in different species but also in the same species, because the amount of acid present differs according to the conditions under which the plants are grown and the particular stage of growth. The poisonous tendencies are generally greatest in the young immature plants, especially in such luscious dark green growths as are apt to follow the application of an excess of nitrogenous manures, heavy rainfall, or irrigation, after a dry spell of weather, and in the stunted growths due to checks caused by drought, frost, or insect and fungous attacks. Generally it is not considered advisable to feed animals on Sorghums until the plants have reached the flowering stage, although sometimes the immature grains may also prove injurious. At maturity, however, most of the Sorghums grown under normal conditions are considered harmless. The danger of poisoning tends to be reduced if the Sorghums are cut and dried before being fed to stock, but drying does not always immediately destroy the toxicity; much depends on the method of drying. The poisonous properties of some of the Sorghums under review will be referred to again under the notes dealing with the utility of the species.

KEY TO THE GROUPS AND SPECIES OF SECTION *EU-SORGHUM*

Subsection **Halepensia**: perennials with well-developed more or less extensively creeping rhizomes; sessile spikelets deciduous when mature, 3·8–6·2 mm. long; grains small, enclosed by the glumes; number of chromosomes usually $2n = 40$; wild Sorghums:

Sessile spikelets more or less obtuse, elliptic to subelliptic or elliptic-lanceolate, 4–5·5 mm. long; glumes coriaceous; lower glume with the keels ending in distinct minute teeth, forming with the subhyaline apex a more or less distinct 3-toothed tip:

Leaf-blades narrow, 0·5–2 cm. wide (rarely more); culms slender, 0·5–1·5 m. high, up to 5 mm. wide; panicles small, often somewhat contracted after flowering, up to 25 cm. long and 5 cm. wide, with the lower branches about 5–8 cm. long. **1.** *halepensis.*

Leaf-blades somewhat broad, mostly 2–4 cm. wide when mature; culms slender to robust, up to 1 cm. wide, usually 2–3 m. high; panicles large, loose and spreading, generally 25–55 cm. long, 10–25 cm. wide, with the lower branches 10–25 cm. long. **2.** *miliaceum.*

Sessile spikelets acute to acuminate; glumes subcoriaceous with somewhat papery tips; lower glume with the keels ending without or with only obscure teeth:

Sessile spikelets 5–6·2 mm. long, acuminate to acute, often awned; panicle small, 15–30 cm. long, lower branches 5–15 cm. long; culms usually 0·5–2 m. high, 0·3–1 cm. wide; leaf-blades narrow, 0·5–2 cm. wide. **3.** *controversum.*

Sessile spikelets 3·8–5 mm. long, abruptly acute with a short fine point, usually awnless; panicle large, 20–60 cm. long, lower branches 15–20 cm. long; culms 2–3 m. high, 1–3 cm. wide; leaf-blades broad, often 3–5 cm. wide. **4.** *propinquum.*

Subsection **Arundinacea**: annuals, or tufted perennials without rhizomes, the tiller-culms arising from basal buds near the foot of the previous season's culms; number of chromosomes usually $2n = 20$ (rarely $2n = 40$):

Series *Sativa*: racemes tough; mature sessile spikelets persistent; grains large, often exceeding the glumes in size, usually much exposed; Sorghums cultivated for their grains or sweet stems (the species of this series are not dealt with in this revision).

Series *Spontanea*: racemes usually fragile, rarely somewhat tough; mature sessile spikelets usually deciduous, sometimes rather tardily; grains small, enclosed by the glumes; wild Sorghums:

Racemes fragile, readily disarticulating at maturity, the sessile spikelets falling together with the adjoining internode of the rhachis and its pedicelled spikelet, or at least its pedicel:

Sessile spikelets lanceolate, 6–8 mm. long, awns 8–18 mm. long; leaf-blades usually 0·5–2 cm. wide, rarely up to 3 cm.:

Panicle long and narrow, 15–60 cm. long, 1–5 cm. wide, with the branches usually suberect; sessile spikelets 6·5–7 mm. long, 2–2·5 mm. wide, acute, awn slender; grains obovate-elliptic, about 2·5–3 mm. long, 1·5–2 mm. wide. **5.** *virgatum.*

Panicle ovate-oblong to lanceolate, 20–40 cm. long, up to 15 (rarely 20) cm. wide, with the branches soon spreading; sessile spikelets 6–8 mm. long, 2–3 mm. wide, shortly acuminate, awn rather stout; grains obovate-elliptic to obovate-oblong, 3–3·5 mm. long, 2–2·5 mm. wide. **6.** *lanceolatum.*

Spikelets not as above:

Sessile spikelets 6–9 (rarely 5·5) mm. long:

Sessile spikelets 2·5–3·5 mm. wide, 6–9 mm. long:

Sessile spikelets 8–9 mm. long, elliptic- to oblong-lanceolate, acuminate, awnless, or more often with an awn 8–16 mm. long; panicle large, loose, 15–45 cm. long, 5–25 cm. wide. **7.** *vogelianum.*

Sessile spikelets 6–8 mm. long, usually with awns 20–30 mm. long:

Panicle very narrow, 10–40 cm. long, 3–10 cm. wide; branches usually suberect; sessile spikelets elliptic- to ovate-lanceolate, usually densely and persistently tomentose with mostly whitish silky hairs; awn 20–30 mm. long. **8.** *aethiopicum.*

Panicle rather wide and loose, up to 35 cm. long, 8–15 cm. wide, branches subflexuous and spreading; sessile spikelets elliptic-lanceolate to elliptic-oblong, shortly and finely, often fulvously, hairy, or at length almost glabrous on the backs of the glumes; awn 20–25 mm. long. **9.** *macrochaeta.*

Sessile spikelets 2–2·5 mm. wide, usually 6–7·5 mm. long, but sometimes reduced to 5·5 mm., elliptic- to oblong-lanceolate; grains obovate-elliptic to obovate, 2–3 mm. long, 1·5–2 mm. wide:

Upper lemma of the sessile spikelet awnless or with an awn 5–10 mm. long; sessile spikelets elliptic- to oblong-lanceolate, narrowly acuminate; leaf-blades usually broad, mostly 3–6 cm. wide; panicle large, loose and much branched, 20–60 cm. long, 10–25 cm. wide. **10.** *arundinaceum.*

Upper lemma of the sessile spikelets with an awn 10–16 (sometimes 18) mm. long; leaf-blades narrow, mostly 1–2·5 (but sometimes 3) cm. wide:

Leaf-blades mostly 45–60 cm. long, narrowing upwards to an acuminate tip; sessile spikelets elliptic-lanceolate, acuminate, 6–7 (or sometimes 5·5) mm. long; panicle pyramidal to elliptic-oblong, at length loose and spreading, 15–50 cm. long, 5–15 cm. wide, lower branches up to 15 cm. long. **11.** *verticilliflorum.*

Leaf-blades up to 30 cm. long; panicle narrow-oblong, 1–2 cm. wide:

Leaf-blades 10–30 cm. long, with a long-tapering filiform tip; sessile spikelets elliptic-lanceolate to elliptic, acute, 5·5–6 mm. long; awn 16–18 mm. long; panicle 10–25 cm. long. **12.** *somaliense.*

Leaf-blades 4–10 cm. long, acuminate; sessile spikelets oblong-lanceolate, acuminate, 5·5–6·5 mm. long; awn 12–14 mm. long; panicle 4–12 cm. long. **13.** *pugionifolium.*

Sessile spikelets 4–5·5 mm. long, 1·5–2·5 mm. wide:

Upper lemma of the sessile spikelet with an awn 10–16 mm. long:

Leaf-blades broad, usually 3–5 (but sometimes 2) cm. wide when mature; panicle wide and loose, 15–50 cm. long, 10–30 cm. wide:

Sessile spikelets elliptic-ovate, acute to acuminate, 4·5–5·5 mm. long, 2–2·5 mm. wide. **14.** *brevicarinatum.*

Sessile spikelets elliptic-lanceolate to elliptic-oblong, obtuse or subacute, 4·5–5·2 mm. long, 1·5–2 mm. wide. **15.** *usambarense.*

Leaf-blades narrow, 1·5–2·7 cm. wide; panicle narrow and loose, up to 40 cm. long and 10–15 cm. wide; sessile spikelets broadly elliptic to elliptic-oblong, obtuse, 4–4·5 mm. long, 2–2·5 mm. wide. **16.** *castaneum.*

Upper lemma of the sessile spikelets with a small mucro; sessile spikelets elliptic to elliptic-oblong, subacute, 4–5 mm. long, 1·5–2 mm. wide; panicle narrow, loose or somewhat contracted, 20–25 cm. long, about 6 cm. wide; leaf-blades (uppermost) 1·5–2 cm. wide. **17.** *panicoides.*

Racemes more or less tough or tardily disarticulating; sessile spikelets persistent or at length deciduous:

Panicle dense and contracted with the rhachis often completely hidden by the branches, 10–20 cm. long, 3–8 cm. wide; leaf-blades broad, 4–8 cm. wide; sessile spikelets ovate to broadly elliptic-ovate, acute to acuminate, 6–7·5 mm. long, 2·5–3·5 mm. wide. **18.** *hewisonii.*

Panicle loose, with the rhachis more or less freely exposed when mature; leaf-blades narrow, 1–3 cm. wide:

Sessile spikelets 6–7·5 mm. long, 2–3 mm. wide, elliptic to elliptic- or oblong-lanceolate, subacute; pedicelled spikelets persistent; grains elliptic to obovate-elliptic, 3·5–4·5 mm. long, 1·5–2 mm. wide. **19.** *sudanense.*

Sessile spikelets 4·5–6 mm. long, ovate, ovate-lanceolate, or elliptic-ovate to elliptic-rotund; pedicelled spikelets deciduous:

Sessile spikelets ovate to ovate-lanceolate, 4·5–5·5 mm. long, 2–2·5 mm. wide, acute to acuminate; grains broad-elliptic to obovate-elliptic, 2–2·5 mm. long, 1·5–1·8 mm. wide; panicle sublinear, about 18 cm. long and 2 cm. wide. **20.** *elliotii.*

Sessile spikelets elliptic-ovate to elliptic-rotund, 4·5–6 mm. long, 2–3 mm. wide, acute to acuminate and closed, or subacute and slightly open at the tip; grains obovate-elliptic to obovate, 3–4 mm. long, 1·5–2·5 mm. wide; panicle oblong to elliptic-oblong, 15–40 cm. long, 8–15 cm. wide. **21.** *niloticum.*

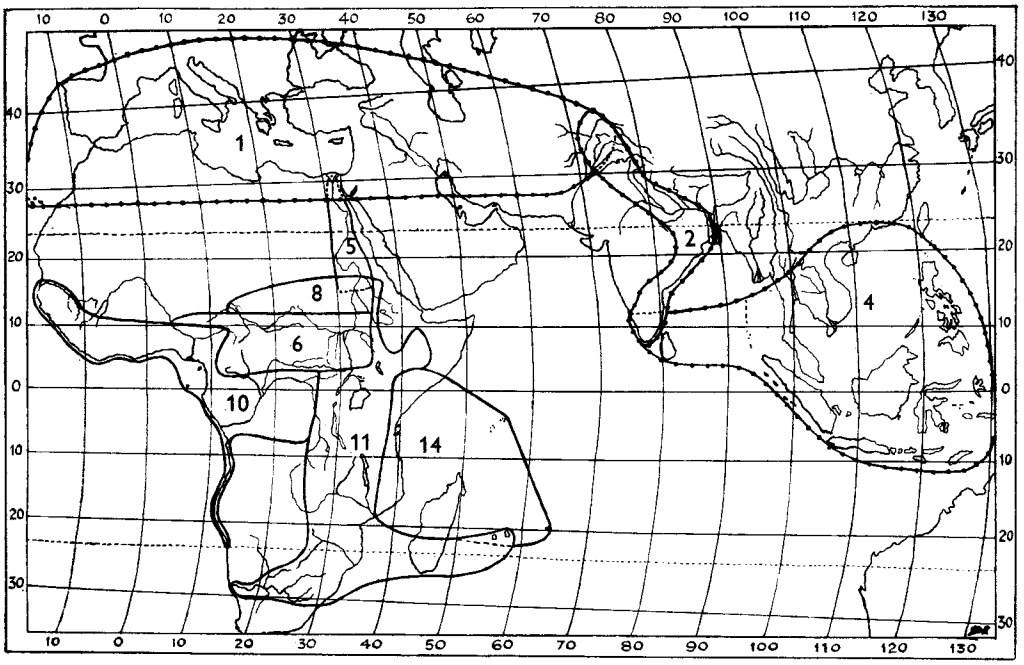
DESCRIPTION AND ENUMERATION

Subsection **Halepensia** Snowden in *Kew Bull.* p. 222, 1935

1. **Sorghum halepense** (Linn.) Pers.

Holcus halepensis Linn., *Sp. Pl.* ed. 1, p. 1047, 1753. When he described this species Linnaeus did not cite any specimens in support of it, but there are two specimens in his herbarium at The Linnean Society of London, and one of them which I have examined is written up *halepensis* in his own handwriting. Linnaeus gives the habitat of his species as Syria and Mauritania.

Andropogon arundinaceus Scop., *Fl. Carn.* ed. 2, **2**, 274, 1772, was the name used for a specimen from Carniola, but Scopoli cites earlier synonyms of Linnaeus and his species is evidently based on *Holcus halepensis* Linn.



Distribution of the chief species: 1, *Sorghum halepense*; 2, *S. miliaceum*; 4, *S. propinquum*; 5, *S. virgatum*; 6, *S. lanceolatum*; 8, *S. aethiopicum*; 10, *S. arundinaceum*; 11, *S. verticilliflorum*; 14, *S. brevicarinatum*.

Milium halepensis (Linn.) Cav., *Descr. Pl.* p. 306, 1802, is founded on *Holcus halepensis* Linn.

Blumenbachia halepensis (Linn.) Koel., *Descr. Gram.* p. 29, 1802, is based on *Holcus halepensis* Linn. His new genus was not generally accepted by other botanists.

Andropogon halepensis (Linn.) Brot., *Fl. Lusit.* **1**, 89, 1804, rests on *Holcus halepensis* Linn.

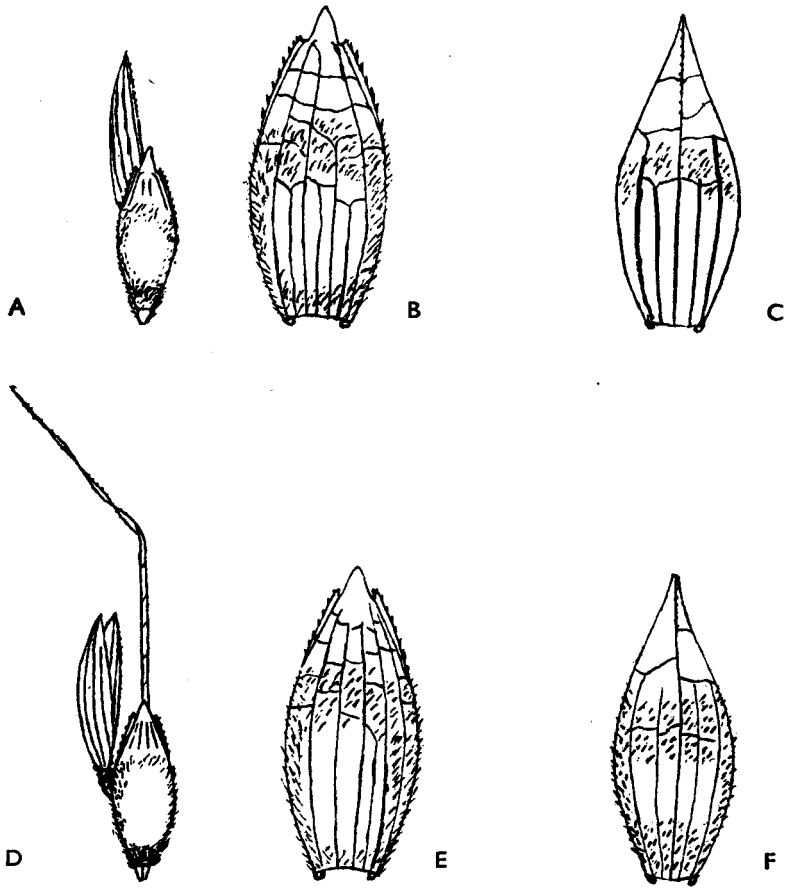
Sorghum halepense (Linn.) Pers., *Synops.* **1**, 101, 1805, is based on *Holcus halepensis* Linn.

Andropogon sorghum (Linn.) Brot. subsp. *halepensis* (Linn.) Hack. var. *halepensis* Hack. in *DC. Monogr. Phan.* **6**, 502, 1889, is founded on *Holcus halepensis* Linn., but besides reducing *halepensis* to a subspecies Hackel also includes some elements in his var. *halepensis*, which in my opinion do not belong to *Holcus halepensis* Linn. Some of the species cited by Hackel in synonomy are therefore excluded, particularly *Andropogon*

laxus Roxb., *Fl. Ind.* **1**, 271, 1820, *A. controversus* Steud., *Synops.* **1**, 391, 1854, and *Sorghum giganteum* Edgew., *J. As. Soc. Bengal*, **21**, 181, 1853, as well as all the varieties of Hackel's subsp. *halepensis* other than var. *halepensis* (sensu stricto).

Description

A perennial with abundant creeping rhizomes 25–75 cm. long, often descending to a depth of 25–50 cm. *Culms* rather slender, mostly simple but sometimes branched, 0·5–1·5 m. high, up to 5 mm. wide near the base. *Leaves* usually 7–10; blades linear, narrowed to a point at the apex, 20–60 cm. long, 0·5–2 (rarely 2·5) cm. wide, the stoutish



Sorghum halepense (Linn.) Pers. (1) A, Sessile and pedicelled spikelets; B, lower glume; C, upper glume, exterior view (awnless form, from *Snowden*, Kew, 1933). (2) D, sessile and pedicelled spikelets; E, lower glume; F, upper glume (awned form; from *Haradjean* 3470). A and D, × 5; B, C, E and F, × 10.

midrib pale green to almost white and contrasting with the darker green of the remainder. *Panicle* loose when in flower, somewhat contracted after flowering, lanceolate to lanceolate-oblong, mostly 10–25 cm. long, and 3–8 cm. wide; branches slender, suberect, one to several from each node, the lower usually about half the length of the panicle, bare of spikelets for 1–5 cm. from the base. *Racemes* fragile, 1- to 5-noded, up to 2 cm. long; internodes and pedicels slender, 2·5–4 mm. long, rather densely ciliate with whitish to tawny or purplish hairs 0·7–1 mm. long. *Sessile spikelets* elliptic to subelliptic, mostly

4·5–5 mm. long, but sometimes up to 5·5 mm., 1·8–2·3 mm. wide, obtuse or subacute, at first more or less hairy and cream to buff-yellow or tawny, with 3–4 nerves evident near the tip of the lower glume, at length often purplish to blackish brown or black and sometimes almost glabrous; awned or awnless; callus-beard copious to somewhat scanty. *Glumes* firmly coriaceous with slightly thinner tips; lower usually 7- to 9-nerved, with a few cross-nerves above the middle, keeled in the upper fourth, the wings of the keels widening upwards to end in minute teeth, forming with the short apex a distinctly 3-toothed tip, spinulously scabrid on the keels; upper 7-nerved, with a few cross-nerves from the middle upwards, rough on the keel in the upper third. *Lemmas* moderately and finely ciliate; lower elliptic to elliptic-oblong, 4–5 mm. long; upper ovate to ovate-elliptic, 3–3·5 mm. long, 1- to 3-nerved, acute and minutely mucronate, or 2-lobed to about 0·5 mm. deep and with an awn 10–16 mm. long. *Anthers* 2·5–3 mm. long. *Grains* light to dark brown, oblong-obovate, 2·5–3 mm. long. *Pedicelled spikelets* at length deciduous, often purplish, ♂ or sometimes neuter, 4·5–6 mm. long; lower glume 7- to 9-nerved, upper 5- to 7-nerved; anthers 2·5–3 mm. long.

Diagnostic characters and affinities

The distinguishing features of *Sorghum halepense* are the abundance of the slender wide-spreading rhizomes, the rather slender dwarf culms, narrow leaf-blades 20–60 cm. long, 0·5–2 (rarely 2·5) cm. wide; small panicles that are usually somewhat contracted after flowering; and the elliptic to subelliptic sessile spikelets, 4·5–5 or sometimes 5·5 mm. long, 1·8–2·3 mm. wide, with the tip of the lower glume obtuse or subacute and distinctly 3-toothed. It is closely related to *S. miliaceum* (Roxb.) Snowden, but the latter has taller culms, larger wide-spreading panicles, and somewhat more elliptic-lanceolate sessile spikelets, as well as shorter thicker rhizomes closely knitted to form dense mats.

Distribution and utility

S. halepense is distributed throughout the Mediterranean Region, where it is most frequent in the islands and coastal lands of the countries bordering the Mediterranean Sea. It also occurs in many inland districts where the soil and climatic conditions are favourable. It is usually found in or near cultivated lands and pastures, but it is also met with on untilled lands, in waste places and by roadsides. Many specimens are recorded as having been collected in, or near the borders of, vineyards, and it would appear that *S. halepense* thrives under similar conditions to those which have been found to be most suitable for Grape Vine cultivation.

The occurrence of *S. halepense* in some areas adjacent to the Mediterranean Sea, such as Portugal, the Canary Islands and Madeira Islands, may be part of its natural distribution or due to some early introduction from Spain and North-west Africa. Eastwards of the Mediterranean its distribution extends across Asia Minor and the Levant to Iran, Turkmen, Afghanistan, Western Pakistan and Kashmir, although in the drier districts of some of these territories it is generally confined to irrigated or cultivated lands. After examining all the Sorghum material available at Kew I am of the opinion that *S. halepense* is not indigenous to any part of India as at present constituted, but is replaced somewhere in the neighbourhood of the North-West Frontier Province of Pakistan and Kashmir by the closely related *S. miliaceum*, which has a more south-easterly distribution and succeeds better in a warmer climate. *S. halepense*, however, must have been introduced into the Punjab and United Provinces of India at some early period, and is now found in most provinces of India, in some cases having been used for the purpose of experimental cultivation and trial as a fodder crop for domestic animals.

During the last hundred and twenty years. *S. halepense* has been introduced into most countries throughout the world where suitable warm-temperate or subtropical conditions prevail. In some of them, such as those of Central and Western Europe, including

southern England (where it is not usually grown for feeding to stock), it is not common, but is sometimes found as an alien on rubbish tips, and waste lands, or occasionally it is cultivated in Botanic Gardens. In countries where the winters are severe, it is rarely able to establish itself under natural conditions, although it may persist in sheltered gardens for many years. On the other hand, in many territories where it has been introduced and cultivated as fodder for stock, it has found conditions so favourable that it has become a noxious weed, difficult to eradicate because of the vigour and abundance of its wide-spreading rhizomes.

It is of interest to note, however, that *S. halepense* has not extended from North Africa southwards into Tropical Africa, nor has it established itself to any great extent in other tropical countries. This may be partly due to the fact that fodder crops are not generally grown for feeding livestock in the tropics and little attention has been paid to its cultivation, but it seems more probable that this species requires a longer growing period to mature than most tropical African Sorghums, as well as a distinct resting-period brought about by cold weather during a comparatively wet season which keeps the rhizomes reasonably moist, in contrast to the conditions prevailing in most tropical countries, where the resting stage usually occurs during the hot dry season when the land is usually baked hard with the sun and the old vegetation often subject to destructive fires.

Attention to the importance of *S. halepense* as a fodder plant was largely due to its successful cultivation in many parts of the United States in the first half of the nineteenth century. According to Piper (in *Proc. Biol. Soc. Wash.* **28**, 27, 1915) it was first introduced from Turkey in 1830. Since then it has been widely cultivated (under the name of Johnson Grass) in many States, especially those south of latitude 36°, where in some districts it has become naturalized. From the United States it has spread to Mexico and many countries of Central and South America, as well as the islands of the Carribean Sea. It has also been grown on a large scale in South Africa and in some States of Australia, especially Queensland, where it has also become naturalized in some areas. During later years its cultivation as fodder has declined to some extent, partly because of the difficulty of eradicating its rhizomes from cultivated lands, and also because of the more recent introduction of *S. sudanense* (Piper) Stapf, commonly known as Sudan Grass, which has been found to provide equally good feed for stock as well as having the advantage of being more easily controlled because of the absence of rhizomes, which is characteristic of the Sorghums of the subsection *Arundinacea*, to which it belongs. Hybrid strains between Sorghums of this latter subsection and *S. halepense* have now been successfully obtained under cultivation in South America. As these are said to have less troublesome rootstocks than the true species it is possible that some of these new varieties may help to restore *S. halepense* to its former good favour. Specimens of these hybrids that I have seen at Kew show close relationship with cultivated Sorghums of the subseries *Drummondii*.

Since the beginning of the present century the poisonous properties of *Sorghum halepense* have received much attention from scientists, and the results of their investigations have been published in various scientific and agricultural journals, including those of the United States of America, South Africa and Australia. Useful data concerning some of these experiments have been brought together in *The Poison Plants of New South Wales*, by Evelyn Hurst, published in 1942. In Montana, United States, the plants were found to be dangerous when growth was stunted, and especially noxious when rank growth was produced in irrigated soils. In Queensland, Australia (according to White, in *Qd Agric. J.* 1934), the plants are least harmful when in full seed. The danger is minimized if the plants are cut and allowed to wilt before being fed to stock. Dealing with Sorghums in the United States in 1935, Ball considered that Johnson Grass contained a greater percentage of HCN than any other cultivated Sorghum. According to the New South Wales Department of Agriculture, the underground parts, which are white and succulent, are said to have caused losses in both cattle and pigs. The results of other experiments show

that positive results of hydrocyanic acid have been obtained both from the older leafy portions and from young leafy shoots. On the other hand, in an experiment where 3 lb. of freshly cut plants, consisting of old shoots, mainly with heads well matured, were fed to sheep of 103 lb. weight, negative results were obtained. It was also found that drying does not immediately destroy the toxicity of Johnson Grass, as lucerne hay containing 75 % of Sorghum caused the loss of twenty-eight head of cattle in an hour, although the hay had been cut 2 days previously and the sun had been hot during that period. In this latter experiment the cattle were very hungry when fed. Strong positive reactions for HCN were obtained both from the hay and the ingesta of the dead animals. The above examples will be sufficient to indicate some of the dangers that may result from using this Sorghum as fodder for stock, especially in the case of freshly cut and immature plants, although in countries where stock have been accustomed to feed on it no harm results under normal conditions, and it provides the animals with good nourishing food.

Forms and varieties

Since *S. halepense* was first recognized as a distinct species, a number of forms or varieties have been described by various authors. A frequent variation of the spikelets is the presence or absence of an awn to the upper lemma. The majority of the plants have awned spikelets, but sometimes in specimens of the same gathering and number the spikelets of one panicle are awned and those of another awnless, and it is not uncommon to find most of the spikelets in a panicle awnless but accompanied by a few that are distinctly awned. The awned form has generally been accepted as typical of the species, and Hackel (in *DC. Monogr. Phan.* **6**, 502, 1889) describes it under *Andropogon sorghum* (Linn.) Brot., subsp. *halepensis* (Linn.) var. *halepensis* subvar. *genuinus* Hack. It is referred to by Stapf (in Hook. *Fl. Brit. Ind.* **7**, 182, 1896) under *A. halepensis* (Linn.) Brot., var. *genuinus* Hack (under which he also includes *Andropogon miliaceus* Roxb.); and by Acherson and Graebner (in *Synops. Mitteleur. Fl.* **2**, Pt. 1, 47, 1898) under *A. halepensis* (Linn.) Brot. var. *typicus*.

The awnless state was described by Hackel, loc. cit., as *A. sorghum* (Linn.) Brot., subsp. *halepensis* (Linn.) var. *halepensis* subvar. *muticus* Hack., and it has also received the following names: *A. halepensis* (Linn.) Brot. var. *muticus* (Hack.) Aschers. & Graebn. (loc. cit.); *A. halepensis* (Linn.) Brot. subsp. *anatherus* Piper (in *Proc. Biol. Soc. Wash.* **28**, 28, 1915); and *Sorghum halepense* (Linn.) Pers. f. *muticum* (Hack.) C. E. Hubbard (in Hook., *Ic. Pl.* **34**, 1938, under t. 3364, p. 4).

A glabrous form of the awned state was described by Hackel, loc. cit., as *Andropogon sorghum* (Linn.) Brot. subsp. *halepensis* (Linn.) var. *halepensis* subvar. *leiostachys*. In addition, Hackel, loc. cit., refers to a broad-leaved form, *Sorghum halepense* (Linn.) var. *latifolium* Willk. & Lange (*Prodr. Fl. Hisp.* **1**, 48, 1861), which is described as 5 ft. high, with leaves ¾–1 in. wide, and a panicle a foot or more long. Although I have seen two of Willkomm's specimens from Spain, neither of them is from the type locality, nor do they agree with the above description. On the other hand, this name and description might well be applied to some of the robust forms, found in Europe and other regions, that have evidently been grown under most favourable conditions and are probably either cultivated plants or grown in or near to cultivated lands.

In contrast to these robust forms there are dwarf specimens with slender culms about 50 cm. high, leaves 0·5–1 cm. wide, and small panicles, that evidently represent impoverished plants grown under adverse conditions, such as infertile soils and low rainfall, or may have resulted from close grazing by stock or frequent cutting for hay. Often such specimens have well-developed rhizomes, and under favourable conditions would have grown into average-sized plants. There are also slender-culmed forms that appear to have matured under shady conditions that have led to elongation and weakness of the culms with looser longer-branched panicles than usual. When grown in the open the

lower branches of the panicle are generally comparatively short except, as sometimes happens, where only one or two of the lowermost whorl develop, because the panicle fails to emerge properly from, or is too tightly held by, the uppermost leaf-sheath. In such cases the remaining branch or two tend to be longer than usual and should be disregarded when reckoning the average length of the panicle branches. The size of the spikelets, also, may differ to some extent according to the robustness of the plants, but they also vary somewhat in shape and size with the stage of development. They are generally longest at the flowering period or immediately after flowering, tending to become a little shorter and narrower as they become more plump and rounded with the increasing size of the grains.

As most of the above forms and variations appear to be mainly due to the influence of climate and habitat, and careful examination of the material at Kew has failed to reveal reliable characters suitable for dividing the species into distinct varieties, I have thought it best to leave these variable forms to be investigated in the field, by growing them under similar conditions, in order to determine if any of them are worthy of varietal status. In the enumeration of the specimens given below, however, the awned state is denoted by an * immediately after the name or number of the collector. A few more notable variations are mentioned in the text.

ENGLAND. Southern counties: Fishponds, Bristol, *Sandwith* *! Brighton, Sussex, *Smart* *! Kew, Surrey, *Snowden*! Middlesex, *Welch* *! Dagenham, Essex, *Lousley**! *Melville* *! Wanstead, *Nash* *!

FRANCE. Mostly in southern districts: Banks of the Loire River, *Perret* *! Avignon, *Hort. Bot. Divionensis* *! *Delacour* *! *Requiem*! Tarascon, *Gay*!

CORSICA. Etang de Biguglia, *Mabille* 66! 66 *! Corté district, *Kralik*, *Pl. Corses* *!

SPAIN. Motril, Granada province, *Willkomm*, *iter Hispanicum* 286! Chiva, near Valencia, *Willkomm*, *iter Hispanicum* 528 *! Near Murcia, *Bourgeau*, *Pl. d'Espagne* 1533 *!

BALEARIC ISLANDS. From sea-level up to 1220 m. Minorca: Fornells (Sept. 1935), *Kennedy* 86 *! Majorca: Pollensa and Aleudia (July, 1936), *Kennedy* 86! 253 *!

PORTUGAL. Near Lumiar, *Welwitsch*, *Pl. Lusitanicae*, *Inlio* *!

SWITZERLAND. At the Rhone dam, near Sion, *Kneucher*, *Gram. Exsicc.* 182!

HUNGARY. Aleppoi Czirok, *Degen in Gram. Hungarica* 101 *!

ITALY. Lombardia district, *Petri Portae* (July 1865) *! (Oct. 1867) *! Near Riva, on Lake Garda, *Kneucher*, *Gram. Exsicc.* 63 *! Parma, *Gay* (Aug. 1826) *! Near Naples, *Alexander* (1845)! (July 1845) *!

SICILY. Near Pelizzi, Nebrodi mountains, *Flora Nebrodensis*, *Strobly* (Aug. 1873) *! Palermo, *Todaro*, *Fl. Sieuta Exsicc.* 496! 496 *!

TRIESTE. Without precise locality: *Prihoda* (Oct. 1864) *! *Tidoll* *!

YUGOSLAVIA. Istria, Zaule, *Schultz herb. normale Englehardt* 2599 *! Near Fiume (Rijeka), *Smith* (July 1869) *! Constantza near Mangalia, *Cretzoiu* (July 1827) *! Isaccea, in Tulcea district, *Cretzoiu* (July 1837) *! Lesina Island, Dalmatia, *Bottori* *!

The specimen from Istria, *Schultz* 2599, is a robust form that may have been grown on cultivated lands.

ALBANIA. Between Durazzo (Durres) and Berat, *Alston & Sandwith* 2516!

This is a robust specimen with the panicle in fruit.

RUMANIA. Without precise locality, *Trivaldski* (1837) *!

BULGARIA. Hills north of Varna, *Gilliat-Smith* 984 *!

GREECE. Macedonia, at Kopriva and south of Karamudli, *Turrill* 368 *! 490! 490 *! Thrace, at Xanthi, *Tedd* 444 *! Attica, *Heldreich*, *Pl. exsicc. de Graecia* *! Drakofto, Pelloponnesus, *Davis* 1012! Without precise locality, in Graecia (Berger) *Mus. Monach* (1837) *!

CEPHALONIA. Without precise locality, in vineyards, *Schimper & Wiest* (1834) *!

CRETE. Canea province: Kissamos and Platania, *Elisée Reverchon*, *Pl. de Crete* (1883 & 1884) 183 *! *Gandoger*, *Herb. Creticum* 7359 *!

TURKEY (in EUROPE). Thrace: Gallipoli, Suala, and Anzac, *Ingoldby* 595! 595 *! *Kett* 90 *!

TURKEY (in ASIA). Antalya, 30 m. *Tengwall* 31 *! Ain-Halakim, Mount Nusairy, 760–900 m., *Haradjian* 3470 *! Near Ermenck, Plains of Cilicia, *Cosson* 213 *! Near Mardin, Kurdistania, *Sintensis* 1341 *! Schiherè sur, Kurdistania, *Hausknecht* (1867)! Karadagh, *Fischer*!

CYPRUS. Kythraeae, *Sintensis* 679 *! Timben and Limassol, 15 m., *Syngrassides* 389! 717 *! Kyrenia, at sea-level, and Platres, 1130 m., *Kennedy* 82! 83 *! 84 *! Near Perapedhi, 1067 m., *Davis* 1851 *! Larnaca, *Ussher* 124 *! Nicosia, *Lindberg* *! Without precise locality, often causing poisoning to animals, *Rae* *!

SYRIA. Northern Syria, Aintab, 610 m., *Haussknecht, Syriaco-Armeniacum* (1865) *! Southern Syria, El Hutch, *Lowe* (1863–4) *! Without precise locality, *Gandoger* (1920) *! *Kneucker Gram. Exsicc.* 63*a* *! *Blanche* 56 *!

PALESTINE. Amaltha, *Hayne* (Oct. 1872) *! Ghor-es-Safieh, *Hart* (1883–4) *! Wad el Kelt, Khan Yubb Yusif to Ain el Tabigha, sea-level to 100 m., ex *American Colony, Jerusalem* B6066 *! B66 *! Northern Circle, poisonous to grazing animals (except horses, mules and donkeys), *Agric. & Forests Dep.* (*Mason*) 4 *! Jerusalem, *Forest Dep.* (*Gabrielith*) 48 *! 48!

TUNISIA. Near Zaghouan, *Kralik* 310 *!

ALGERIA. Oran province, Sidi-bel-Abbès, *Warion* 2286 *! Alger province, Blidah, *Lefebre* 186! Stora, *Bové* (Aug. 1889)!

MOROCCO. Southern Morocco, Mzuda, *Hooker* (May 1871) *!

CANARY ISLANDS. Gran Canaria, Beo de Angustura, ex *Herb. Monig. Murray* *! Without precise locality, presented Hooker, Feb. 1868, *Gay*!

MADEIRA ISLANDS. Near Gorgulho, ex *Herb. Monig. Murray* *! *Mandon* 262! Near Funchal, *Clarke* 94 *! *Grabham* 31! *Lowe* 26! Dos Saltos, *Hooper* (Jan. 1842) *! Without precise locality, *Lawrence* (July 1837) *! *Leman*! *Lowe*! Masson *!

BELGIAN CONGO. Introduced as a fodder plant, Eala, *Lebrun* 604!

SOUTHERN RHODESIA. Introduced for trial as a fodder plant, Agricultural Experiment Station, Salisbury, *Mundy* 50*b*, *Trapnell* 754 *! Insiza, 1370 m., *Capstick* 2328 *! Lomagundi district, 1070 m., *Eyles* 3149 *!

PORTUGUESE EAST AFRICA. Zambesi Delta, Boruma, *Meynharth* 1046 *!

SOUTH AFRICA. Transvaal: Pretoria, Froenkloof Experiment Farm, and without precise locality, *Nat. Herb. Pretoria* H. 20939 *! 8498 *! (Waterval No. 7) 1544 *! Natal: in Botanic Gardens, not indigenous, *Medley Wood* 6675!

Medley Wood's specimen has a loose panicle and looks as though the plant had been grown in a shady habitat.

IRAQ. Northern district, *Imperial Institute* I! Remount Farm, Karredah, *Graham* *! West Baghdad, *Rogers* 0303! Rustam Experimental Farm, Baghdad, *Lozer* 3416 *! *Guest* 184! 275 *! 2459 *! Aziziyah, *Guest* 3567! Zauritch, 915 m., *Guest* 3750! Basra, *Haussknecht, Syriaco-Armeniacum* (1865)!

IRAN. Near Teheran, *Trott* 863 *!

TURKMEN (TURCOMAN). Kizil Arvat, Karakala, *Sintensis* 1890!

AFGHANISTAN. Without precise locality, *Griffith* 356 *! 661 *! 6825!

PAKISTAN. Baluchistan: Bolan Pass (ex Herb. Leman, 1852) *Griffith* *! Chitral, 1500 m., *Harris* *! Drosh, 1370 m., *Toppin* 307 *! Without precise locality, *Wingate* *! Gilgit: Hunza Valley, 1675 m., *Duthie* 12318 *!

KASHMIR. Shadipur—Jhelum Valley, *Ludlow & Sherriff* 7803! Without precise locality, near towns, *Jacquemont* (388) 656 *! *Herb. Falconer* *!

INDIA. Punjab: West of Chenab River, *Hooker & Thomson* (Nov. 1846) *! Plains below Mumior, *Hooker & Thomson* *! Bhyrowal, 45 miles east of Lahore, *Hooker & Thomson* (Sept. 1846) 1542! Timoo Ghat, *Hooker & Thomson* (Oct. 1846)! Without precise locality, *Hooker & Thomson* *! Jellundur, *Wingate* (Sept. 1888) *! In valley

below Nahan Sirmur, *Jacquemont* (144) 2518! United Provinces: near Mustafabad, *Hooker & Thomson* (Oct. 1846)! Bengal: Botanic Gardens, Calcutta, *Narayanaswami* (April, 1918) *! Serampore, *Griffith* *! Madras: Samalkota, Godaveri district; Betta Mogilam, Hosur, and Metigiri, Salem district, *Madras Herb. S. India Flora* (June 1917) *! (Dec. 1913)! (Dec. 1916)! 15451 *! Shencottah to Aryankavu, Travancore State, *Calder & Ramaswami* 669 *! Province and locality uncertain, *Wight Herbarium* 1673 *!

Robust specimens from plants used for hybridization experiments with *Saccharum*, *Janaki Ammal* 1236, which have persistent spikelets, are probably hybrid forms of *Sorghum halepense*. A specimen from the Botanic Gardens, Calcutta, *Nashe* 1317, which also has persistent spikelets, may have resulted from intercrossing between *S. halepense* and a cultivated Sorghum.

CEYLON. Peradeniya Herbarium (seeds from Drieberg) *Galston* 2240!

JAVA. Without precise locality, *Posthumus* 89!

A poor specimen from Java, raised from seeds introduced from Valparaiso, *Brigsman* (Mar. 1914), may belong to *S. halepense*, but the material is too scanty for exact determination.

FORMOSA. Kontay Experiment Station, near Koshun, from a sample of Johnson Grass hay, *Price* (June 1912) *!

AUSTRALIA. Western Australia: Bassendean, *Palmer* *! Bayswater, near Perth, *Stoward* 234! Williambury, Minilya River, *Bunbury* *! Queensland: near Brisbane, *Bailey* (Dec. 1913) *! *Blake* 318 *! Burpengary, *Blake* 136 *! Cloncurry, *Blake* 201! Near Brisbane; Moreton district; between Grandchester and Laidley; near Mt. Gravat; between Laidley and Forest Hill; and between Teirotville and Anthony, *Hubbard* 3026! 4316 *! 4732 *! 5285 *! 5352 *! 5388! 8075 *! 8906 *! Forest Hill, *White* 5 *! Johnson River, *Harding* (Nov. 1907) *! Kigaroy, *Jensen* *! Atate Farm, Hermitage, Warwick, *Liverseed* 8 *! Riversleigh Eidsvold Line, *Turner*! Christmas Creek, *McIntyre Bros.* 7! New South Wales: Ashfield, *Cheel*! Without precise locality, *Brisbane Botanic Gardens Herbarium* 9 *! Victoria: Without precise locality, *National Herbarium, Melbourne*!

NEW ZEALAND. Napier, naturalized, *Kirk* 1387 *!

FIJI ISLANDS. Introduced experimentally to feed stock but now a troublesome weed, without precise locality, *Greenwood* 392!

Greenwood's specimen has rhizomes and leaves typical of *Sorghum halepense* but it has no inflorescence.

HAWAII. Nuwanu Valley, Oahu, *Forbes*!

UNITED STATES. California: Redding, Shasta county, *Smith* 744 *! Santa Cruz county, *Woolley-Dod* 453! Mesa Grande, 760 m., San Diego county, *Spencer* 1393 *! Oklahoma: Harmon county, *Stevens* 1087! Texas: San Antonio, Bexar county, 185 m., *Heller* 1706 *! Without precise locality, ex United States National Herbarium, *Walley* (1886) *! Arkansas: Van Buren Bluffs, Crawford county, *Demaree* 3167! Louisiana: Without precise locality, *Ball* 80! Tennessee: Near Nashville, *Curtiss* 3644A! Virginia: Norfolk, *Hitchcock* 277! South Carolina: near Columbia, *Curtiss* 3644 *! Florida: Indian River, Merritt Island, *Curtiss* 5724! Hillsborough county, *Fredholm* 6346! Miami and Buena Vista, Dade county, *Moldenke* 522! 704 *!

Only a few spikelets of Moldenke's 704 are awned.

MEXICO. Sonora: Guamas, *Palmer* 64! Coahuila: Saltillo, 1600 m., *Arsène* 3464 *! Nuevo Leon: near Monterrey, 540 m., *Abbon* *! *Arsène* 498 *! Michoacan: Zitacuara to Las Anonas and to San Jose Purua, 1575–1775 m., *Hinton* 13140 *! 13270! 13270 *! Guerrero: Pungarabato, Coyuca, *Hinton* 5457! Mexico: Temaxcaltepec district, 1750 m., *Hinton* 4031! 1427! 1427 *! Yucatan: Izamal, Gaumer 720!

The specimen *Hinton* 4031 has the appearance of having been grown in a shady habitat.

BERMUDA ISLANDS. Paget, and Trott's Pond, *Brown & Britton* 130! 135!

CUBA. Near Havana, *Curtiss* 561 *!

PORTO RICO. Finca, Bueno Causejo, Rio Piedras, *Hioraw* *!

SANTO DOMINGO. Cibas Valley, Santiago province, *Ekman*!

JAMAICA. Blue Mountains district: St Andrew and Resource, *Perkins* 1479 *! 1139 *! Resource, 1100 m., *Harris* 11521! 1000 m., *Harris* 11582 *! Richmond Park, St Andrew, *Harris* 12706! Hope Grounds, 215 m., *Harris* *! Without precise locality, *Botanic Department, Jamaica* 2004 *!

The unnumbered specimen of *Harris*, from Hope Grounds, has only a few spikelets with awns.

ST LUCIA. Near Government Experiment Station, Union, *Box* 323!

COSTA RICA. Las Concavas, *Lankester* 210 *!

VENEZUELA. Cetu, Caracas and La Guayra, 610–915 m., *Fendler, Plantae Venezuelanae*, 1854–55, 1653! Caracas, 915 m., *Munro, Plantae Venezuelanae, July* 1858, 2629! Cumana, *Fünckе* 245!

BRITISH GUIANA. Botanic Gardens, Georgetown, *Actson* 115 *!

This specimen is a shady habitat form.

PARAGUAY. Cordillera de Altos, *Hassler, Plantae Paraguarienses*, 3346 *!

ARGENTINA. Villa Sujan, 460 m., Tucuman province, *Venturi* 313 *! Near Cnel. Roca, 250–360 m., *Fischer* 216! Near Santa Fé, Santa Fé province, *Job* 1067 *!

URUGUAY. Soriano, Mercedes district, *Berro* 6387 *!

2. **Sorghum miliaceum** (Roxb.) Snowden

Andropogon miliaceus Roxb., *Fl. Indica*, **1**, 276, 1820, is based on specimens grown at Calcutta from seeds collected in the mountains north of Oude, which were sent from Lucknow under the name of Hill Grass. There are no authentic specimens of Roxburgh's plant at present known to me, but the drawing of it, no. 1717 in Icones Roxburghianae[1], illustrates the large size and loose branching of the panicle, and the dissections of the sessile spikelets show them to be short and wide with the apex obtuse, as stated in Roxburgh's description. Two enlarged drawings of the sessile spikelets are given. In one of them the upper lemma has a short awn less than twice the length of the lemma, but in the other it is awnless. The glumes are shown as shortly hairy and the lemmas as shortly ciliate. Roxburgh states that the leaves are ensiform-lanceolate, 2–3 ft. long and 1–2 in. wide near the base where they are broadest.

Andropogon miliformis Schultes, *Mantissa*, **2**, 448, 1824, is a change of name for *A. miliaceus* Roxb. This change of name was made by Schultes because the name *A. miliaceum* had appeared (without description or author) in Brouss., *Cat. Monsp.* p. 5, 1804, among several other species of *Andropogon*, also without descriptions or authors except for *A. aculeatum* Forsk., which appeared near the bottom of page 4.

Roemer et Schultes, *Syst. Veg.* **2**, 828, 1817, refer in a note to four species of *Andropogon*, which are insufficiently known to them, thus:

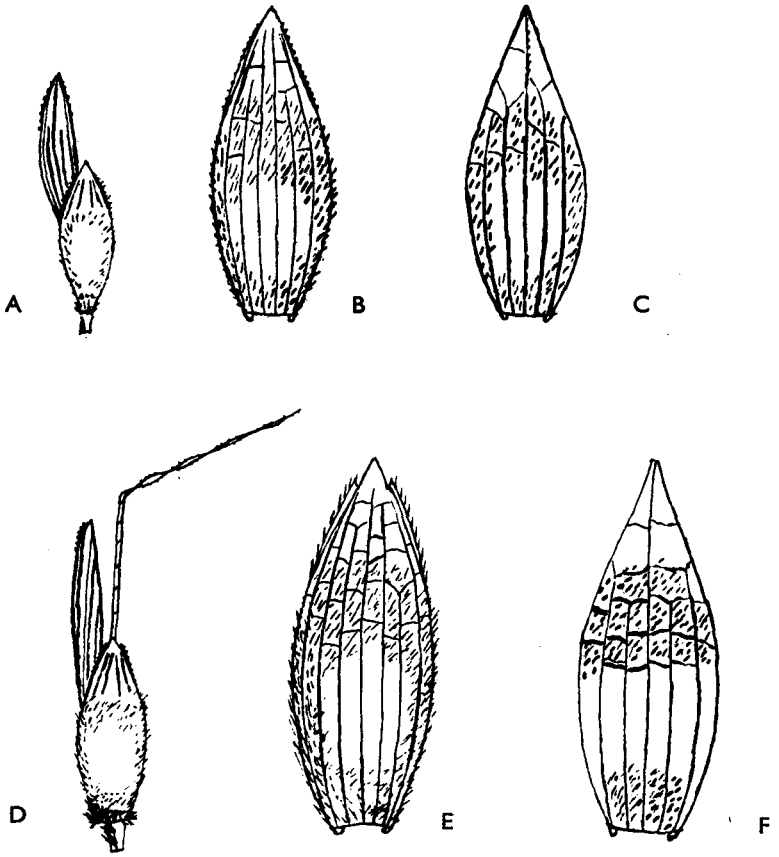
Quid: *Andropogon foveolatus* Descript de l'Egypt, t. 8?
A. aculeatus Forsk. apud Brouss., *Cat. Monsp.* 1804.
A. miliaceus Forsk. apud Brouss., *Cat. Monsp.* 1804.
A. radiatus P. de Beauv.

There is nothing in Brouss., *Cat. Monsp.* 1804 to connect Forskal with *A. miliaceum*, and it seems possible that Schultes may have been mistaken in assuming that because it appeared immediately below *A. aculeatus* Forsk. in Roemer et Schultes, loc. cit., *A. miliaceus* was also one of Forskal's species. Kunth, *Enum. Pl.* **1**, 507, 1833, and Dietrich, *Synops. Pl.* **1**, 410, 1839, refer to *A. miliformis* Schultes as a synonym of

[1] These Icones consist of a few sets of unpublished drawings of Roxburgh's plants, one set of which I have seen at Kew.

A. miliaceus Roxb., and Steudel, *Nomencl. Bot.* ed. 2, **1**, 92, 1840, refers to the latter as *A. miliaceus*, Brouss., Forsk., Aegyptus? Hackel, in *DC., Monogr. Phan.* **6**, 1889, makes no reference to *A. miliaceus* Forsk., but (loc. cit., p. 541) places *A. miliformis* Schultes in synonomy under *A. miliaceus* Roxb.

In Roxburgh's *Hortus Bengalensis*, p. 1814, *A. miliaceus* is stated as having been received from General Martin, from Hurdwar (probably north of Delhi). As General Claude Martin died on 13 September 1800, the seeds must have been sent to Roxburgh,



(1) *Sorghum propinquum* (Kunth) Hitchc. A, sessile and pedicelled spikelets; B, lower glume; C, upper glume, exterior view (from *Loher* 1807). (2) *S. miliaceum* (Roxb.) Snowden var. *miliaceum*. D, sessile and pedicelled spikelets; E, lower glume; F, upper glume, exterior view (from Snowden, Kew, Sept. 1933). A and D, × 5; B, C, E and F, × 10.

who came to the Calcutta Gardens in 1793, between the latter date and 1800. As Roxburgh was exchanging seeds, etc., with Sir Joseph Banks, and Broussonet mentions receiving seeds from Sir Joseph, it is quite possible that the *A. miliaceum* mentioned by Broussonet was that of Roxburgh, and had been raised from seeds sent to Sir Joseph Banks by Roxburgh and passed on to Broussonet. After considering all the available evidence, I have come to the conclusion that there was only one *A. miliaceus*, namely the one described by Roxburgh in *Fl. Indica*, **1**, 276, 1820.

Sorghum giganteum Edgew., *J. As. Soc. Bengal*, **21**, 181, 1853, was described in an account of the plants growing in the Banda district, Allahabad division, of the United Provinces, India. Both from the description and from the locality, it is evident that this species is the same as the one Roxburgh had previously described as *Andropogon milia-*

ceus. The type specimen of Edgeworth's species has not been located, but in his herbarium at Oxford there is a specimen, no. 361, 'Keirat Rangal', which agrees with the above description and may be part of the same gathering.

Sorghum miliaceum (Roxb.) Snowden, comb.nov., based on *Andropogon miliaceus* Roxb., *Fl. Indica*, 1, 276, 1820, for the reasons already mentioned above, is here proposed as the correct name for this group.

There are three specimens in the Wallich Herbarium at Kew, nos. 8778 A, B and C, that belong to this species and agree well with the illustration no. 1717 in Icones Roxburghianae, especially if the panicles had been spread out in a more natural manner when mounted. Of these I select no. 8778 B to be linked with the above drawing of Roxburgh's plant, as a typical specimen, to be used until a more authentic type has been located.

Description

A tall loosely tufted perennial with short thick somewhat densely matted rhizomes. *Culms* slender to rather stout, 2–3 m. or more high, 0·5–1 cm. wide near the base, simple or branched above. *Leaves* about 10–12; blades ensiform-lanceolate to linear, from a rather broad base, gradually attenuated upwards to the pointed apex, 30–90 cm. long, 1–4 cm. wide, more or less smooth except for the serrate-ciliate margins, the midrib paler than the remainder and somewhat prominent below. *Panicle* large, loose and spreading, ovate-elliptic, ovate-lanceolate, or pyramidal, mostly 25–55 cm. long, and 10–25 cm. wide; branches subverticillate, slender and flexuous with the tips often drooping, lower often 4- to 5-nate, 10–20 cm. long, often naked for 2–5 cm. from the junction with the main axis. *Racemes* fragile, 2- to 5-noded, 10–22 mm. long; internodes and pedicels slender, 2–4 mm. long, densely ciliate with whitish to fulvous or tawny hairs 0·5–1 mm. long. *Sessile spikelets* elliptic-lanceolate to subelliptic, more or less obtuse, 4–5·5 mm. long, 1·5–2·3 mm. wide, straw yellow to deep cream with 3–5 greenish nerves showing near the tip of the lower glume when young, at length tawny to mahogany red or almost black, sparingly strigose, especially near the base, sides and above the middle; awned or awnless; callus densely to moderately bearded. *Glumes* coriaceous, but somewhat thinner towards the tips; lower 8- to 12-nerved, with a few cross nerves above the middle, keeled in the upper third, with the keel-wings spinulously ciliolate and ending in minute teeth below the hyaline apex to form a 3-toothed tip; upper 7-nerved, the two adjoining the median nerve often rather short, with a few cross nerves in the upper half, scabrid on the keel in the upper third. *Lemmas* moderately to sparingly ciliate; lower elliptic-oblong to elliptic-lanceolate, 3·5–5 mm. long; upper ovate to ovate-elliptic, 2·5–4 mm. long, 2-lobed to 0·5–1 mm. deep and with an awn 10–16 mm. long, or sometimes subentire and mucronate. *Anthers* 2·5–3·5 mm. long. *Grains* obovate-elliptic to obovate-oblong 2–2·5 mm. long, 1–1·5 mm. wide, yellowish brown to dark purplish brown; embryo-mark obscure. *Pedicelled spikelets* usually ♂, 5–6·5 mm. long, at length deciduous, often purplish; glumes herbaceous, lower 7- to 8-nerved, upper 5- to 7-nerved; lemmas well developed; anthers 2·5–3·5 mm. long.

Diagnostic characters and affinities

The distinguishing features of *Sorghum miliaceum* are the thick rhizomes; tall culms 2–3 m. or more high; leaf-blades 1–4 cm. wide; large loose panicles, mostly 25–55 cm. long, 10–25 cm. wide; sessile spikelets elliptic-lanceolate to subelliptic, more or less obtuse, 4–5·5 mm. long, 1·5–2·3 mm. wide, awned or awnless; and the coriaceous glumes, with the lower more or less distinctly 3-toothed at the tip. It is closely related to *S. halepense* but differs from it in the thicker rhizomes, taller culms, wider leaf-blades, larger panicles, and the sessile spikelets usually tending more towards elliptic-lanceolate

in outline. From *S. controversum* it differs in the comparatively broader and more obtuse sessile spikelets, the more coriaceous and less hairy glumes, with the lower more distinctly 3-toothed at the tip, and the broader leaf-blades up to 4 cm. wide.

Distribution and utility

The natural distribution of *S. miliaceum* extends from Kashmir and the North-West Frontier Province of Pakistan, across northern India, including the Punjab, United Provinces, Central Provinces, and Bengal, southwards to Madras Province. Its taller and more robust culms indicate that it is more of a jungle grass than *S. halepense*, and this is confirmed by it having been found growing in forests, probably in clearings or near the outskirts. Little information is available as to its cultivation and its introduction into other countries, but it has been grown experimentally in the United States, and also at Kew. It may also have reached Mexico, either from the United States or direct from India as some Mexican specimens, referred to below, are remarkably like the typical *S. miliaceum* of India.

According to Piper (who refers to it under *Andropogon halepensis miliformis* Schultes, in *Proc. Biol. Soc. Wash.* **28**, 29, 1915) seed collected by Hartless at Saharanpur, in the United Provinces of India, was introduced into the United States and cultivated at Arlington Farm, Virginia, where the plants grew to a much larger size than those of typical *Sorghum halepense*, and differed conspicuously in the larger looser panicles, besides having very abundant short thick rootstocks in a dense tangled mass. In the Royal Botanic Gardens, Kew, where in 1933 I collected specimens of a *Sorghum* which proved to be *S. miliaceum*, from plants that were growing near to some clumps of *S. halepense*, similar differences were also noticeable, as well as the broader leaves, 3–5 cm. wide. Unfortunately all the plants of *S. miliaceum* at Kew have since died, apparently being unable to survive the English winters, although those of *S. halepense* have persisted for more than twenty years.

As *S. miliaceum* has not generally been recognized as distinct from *S. halepense*, there is little information available regarding either its utility or its toxic properties. Although its stouter culms and wider leaves would provide plenty of good fodder, it might not be so easy to handle with machinery. The plants would also seem to require a warmer climate than those of *S. halepense*, and their thick rootstocks might be just as difficult to eradicate as those of the latter species. On the other hand, *S. miliaceum* is likely to prove more suitable than *S. halepense* for cultivation under tropical conditions in countries where there is no cold winter season.

(i) Var. **miliaceum**

Var. **miliaceum** is the typical variety founded on *Andropogon miliaceus* Roxb. (*Fl. Indica*, **1**, 276, 1820) and *Sorghum giganteum* Edgew. (*J. As. Soc. Bengal*, **21**, 181, 1853). As the type specimens of the above species have not yet been located, I have selected *Wallich* 8778B, in the Wallich Herbarium at Kew, linked with Icones Roxburghianae Fig. no. 1717, to be used in their place until they are found.

Sessile spikelets 4·8–5·5 mm. long, 1·8–2·3 mm. wide, usually awned; panicle with the lower branches usually 1- to 4-nate, stoutish and stiff below after flowering, slender and flexuous upwards.

England. Growing in herbaceous grounds, Royal Botanic Gardens, Kew, Sept. 1933, *Snowden*!

Pakistan. North-West Frontier Province: Hazara, Hilkoti, Saran Range, *Inayat* (Sept. 1898) presented *Duthie*! Hazara, Kagan Valley, *Inayat* (Aug. 1896; Herb. Bot. Dep. N. India 20294*a*) presented *Duthie*! Gilgit, *Winterbottom* 976!

Kashmir. Sunajar, 1615 m., *Gammie*! In Kashmir valley, 1676 m., ?*Clarke* 14805A!

INDIA. Punjab: Karnal—Ghogripur, *Drummond* 21,089! 21,090! Umritsur, *Clarke* 22,226A! 22,226B! Chumba, 1524 m., and 914 m., *Clarke* 23,519! 24,308A! Himalayas, *Barogh*, 1524 m., *Rich* 908! United Provinces: Mahannddee below Muldah, *Hooker & Thomson* (May, 1850)! Saharanpur, *Gov. Botanic Gardens* (Sept. 1884)! Kampti Falls near Mussoorie, 1067 m., *Stewart*! Province and locality uncertain, *Wallich* 8778B! Central Provinces: Chanda forests, along streams, *Haines* 5318! Allapalli, *Haines* 3647! Bihar and Orissa: Baudh State, near Tikerapara, *Mooney* 634! Madras: Rampa county, beyond Erragonda, Godaveri district, *Narangaswami* 542! Nilgiris, S.E. Wignaad, Gudalur, 914 m., *Gamble* 15,422! Khoondas, near water, *Hohenacker* 1284! Hill Grove, *Bourne Herbarium*! Begur, Malabar, Wyanaad, 762 m., *Fischer* 4511! Nungambakam, *Herb. Madras. Myson*!

ASSAM. Without precise locality, *Fielding*!

Several of the above specimens, including those of *Clarke*, *Mooney*, and *Fielding*, are weak or shady-habitat specimens. *Hohenacker* 1284, from Khoondas in the Nilgiris, matches the specimen from plants grown in the Royal Botanic Gardens, Kew.

Andropogon halepensis subsp. *miliformis* (Schult.) Piper (in *Proc. Biol. Soc. Wash.* **28**, 28, 1915), in so far as it is based on *A. miliaceus* Roxb., comes under this variety. The species *A. laxus* Roxb. and *A. controversus* Steud., cited in synonomy by Piper, are here excluded, however, and will be described below under *Sorghum controversum*. In his description of *Andropogon halepensis* subsp. *miliformis* Piper gives the width of the leaves as 5–15 mm., whereas in the material I have examined at Kew the leaves of *Sorghum miliaceum* are often 3–4 cm. wide. I have been able to accept only four of the specimens in Kew Herbarium cited by Piper as belonging to *S. miliaceum*, the others I think are better placed under *S. halepense*. I have not seen any of the specimens of the plants referred to by Piper as having been grown in the United States and none of the specimens from that country that I have examined at Kew belongs to *S. miliaceum*. It seems possible that the plants mentioned by Piper failed to establish themselves in the United States, but died out like those grown in the Royal Botanic Gardens, Kew.

The following specimens from Mexico, however, which have tall culms, broad leaves, and large panicles, agree well with *Sorghum miliaceum*. It is possible that they may be the progeny of some of the plants grown in the United States, or from seed introduced direct from India, but it is difficult to account for their appearance in Mexico and, until further information is available, they are somewhat doubtfully placed here:

MEXICO. Sonora: north-eastern Sonora, Colonia Morelos, 800 m., *Santos* 1879! Chihuahua: Guasaremos, Rio Mayo, *Scott Gentry* 2375! Nuevo Leon: Fundicion, near Monterrey, *Arsène* 708! Guerrero: Coyuca, *Hinton* 5552!

(ii) Var. **parvispicula** Snowden

Var. **parvispicula** Snowden, var.nov. Spiculae sessiles 4–4·5 mm. longae, 1·5–1·8 mm. latae, plerumque muticae; panicula nutans rami inferiores 5–7-nati, in totum graciles et flexibiles.

Sessile spikelets 4–4·5 mm. long, 1·5–1·8 mm. wide, usually awnless. Panicle nodding, lower branches 5- to 7-nate, slender and flexuous throughout.

The type of this variety is a specimen in Kew Herbarium, *Gamble* 27,139, collected at Dehra Dun, United Provinces, India.

PAKISTAN. Western Himalaya: Baru, *Duthie*! West Punjab: Rawalpindi, *Aitchison* 116!

INDIA. East Punjab: without precise locality (near Karnal?) *Drummond* 21,088! United Provinces: Dehra Dun, 670 m., *Gamble* 27,139! Dehra Dun, in new forest, 670 m., *Umrao Singh* 383! Province and locality uncertain, *Wallich* 8778A! 8778C! Madras: Syadapet (Saidapet), Government Farm (Nov. 1885) *Gamble Herbarium*! Nilgiris, Burliar, 914 m., *Gamble* 14,380! Coimbatore, 1310 m., *Raju & Nagathan* 4927! Salem,

Hosur Cattle Farm, 914 m., *Narangaswami* 3061D! Kudirai Madai, 990 m., *Narangaswami* 3944D! Biligirirangano, N. Coimbalai–Mysore, *Alagranathan*! Dindigul, 914 m., *Wallich* 8778D (2)!

The panicle of *Wallich* 8778D (2) is rather weak and depauperate.

3. **Sorghum controversum** (Steud.) Snowden

Andropogon laxus Roxb., *Fl. Indica*, **1**, 275, 1820, was the name originally given to this species, but it was changed by Steudel because of the earlier *A. laxus* Willd. It was described from plants growing in north-east India that were locally known by the names *Kalamoocha* (Beng.) and *Gaddi-janoo* (Teling.). The figure no. 894 in Icones Roxburghianae shows its loose spreading panicle, and gives dissections of the sessile spikelets.

A. controversus Steud., *Syn. Pl. Glum.* **1**, 391, 1854, is based on *A. laxus* Roxb., loc. cit., the change of name being necessary on account of the older *A. laxus* Willd., *Sp. Pl.* **4**, 907, 1806.

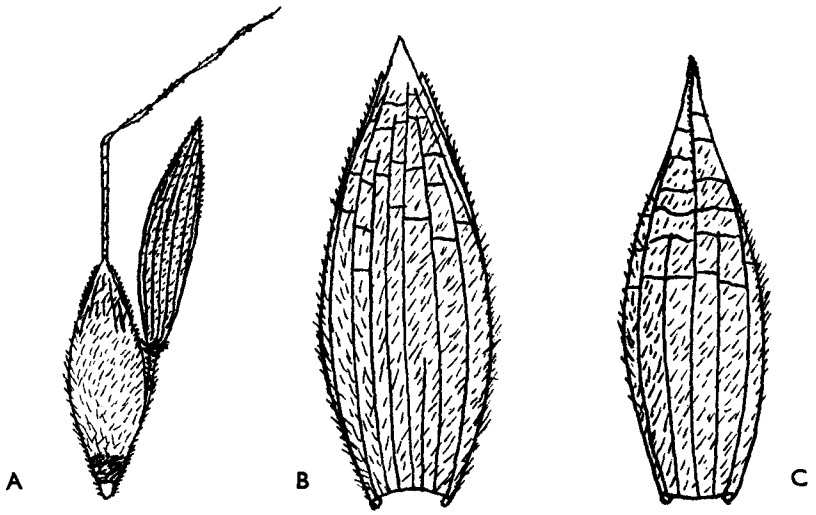
Sorghum controversum (Steud.) Snowden, comb.nov., is a change that is necessary on transferring this species to the genus *Sorghum*.

No authentic type specimen of *Andropogon laxus* Roxb. has been located, but in the Wallich Herbarium at Kew there is one sheet written up *A. laxum* and marked H.B., which suggests that the two specimens mounted on the sheet may have been grown in Hort. Bot. Calcutta, from seed of the plants from which the illustration in Icones Roxburghianae was drawn. The right-hand panicle of this sheet certainly agrees well with the illustration, but it differs in having the sessile spikelets awnless. Awned and awnless states belonging to the same species, however, are common in certain species of the subsection *Halepensia*, and these Wallich specimens agree with awnless states of *Sorghum controversum* that have been received at Kew from south-east India. The right-hand panicle of *Wallich* 8778H has therefore been selected as typical of the awnless state of this species, to be linked with figure no. 894 in Icones Roxburghianae. Until Roxburgh's type specimen has been located, a specimen in Kew Herbarium, *Bourne* 3270, from Tapeswarani, Godavery district, Madras province, dated December 1907, has been selected as characteristic of the awned state of this species.

Description

A more or less loosely tufted perennial, with the rhizomes often somewhat woody. *Culms* erect or sometimes decumbent near the base and rooting at the lower nodes, slender to stoutish and tending to become woody, 0·3–1 cm. wide, 0·5–2 m. high, or sometimes (according to Roxburgh) under favourable moist shady conditions, such as river banks, etc., attaining a height of 3–4·5 m. *Leaves* few to many; blades linear, from a rounded and slightly contracted base, gradually narrowing upwards to the acuminate apex, 12–35 or sometimes 60 cm. long, mostly 0·5–2 cm. wide, more or less smooth except for the scabrous margins. *Panicle* ovate to pyramidal, loose and spreading, often nodding, 15–30 cm. long, 5–15 cm. wide; branches subverticillate, widely spaced, slender and flexuous, except near the base, woolly near the junction with the main axis and in the axils of the divisions, the lower usually 3- to 4-nate, 5–16 cm. long, often naked for 1–5 cm. from the base. *Racemes* fragile, 2- to 5-noded, 8–22 mm. long; internodes and pedicels slender, 2–4 mm. long, densely ciliate with whitish to tawny or pale purplish hairs 0·7–1 mm. long. *Sessile spikelets* elliptic-lanceolate to subelliptic, acute to acuminate, 5–6·2 mm. long, 1·5–2·2 mm. wide, pale straw to cream colour with 3–5 nerves evident near the tip of the lower glume when young, at length tawny to purplish, usually more or less densely softly hairy throughout; awned or sometimes awnless; callus short and narrow, densely bearded. *Glumes* rather thin and subcoriaceous with somewhat papery tips; lower usually 9- to 11-nerved, finely keeled from about the middle or in the

upper third, with the narrow keel-margins ending in minute teeth or sometimes merging almost imperceptibly into the hyaline apex, finely spinulously ciliolate on the keels; upper 7-nerved, with two or sometimes four of the lateral nerves often rather short, slightly scabrid on the keel in the upper third or fourth. *Lemmas* densely but finely long-ciliate; lower elliptic-lanceolate to elliptic-oblong, 4–4·5 mm. long; upper ovate to elliptic-ovate, 3–4 mm. long, 2-lobed to 0·7 or 1 mm. deep, with an awn 10–14 mm. long or sometimes with a mucro 1–3 mm. long. *Anthers* 3–3·5 mm. long. *Grains* (immature?) obovate-elliptic, 2–2·5 mm. long, 1–1·3 mm. wide, tan to reddish brown. *Pedicelled spikelets* linear-lanceolate to subulate, usually ♂, 4·5–7 mm. long, 1–1·5 mm. wide, straw yellow or more often purplish, sparsely shortly hairy; glumes thin and papery, lower 7- to 9-nerved, upper 5- to 7-nerved; lemmas large, well developed; anthers 2–3·5 mm. long.



Sorghum controversum (Steud.) Snowden. A, sessile and pedicelled spikelets; B, lower glume; C, upper glume of sessile spikelet, exterior view. A, × 5; B and C, × 10. (From *Bourne* 3270.)

Diagnostic characters and affinities

The most distinctive features of this species are the somewhat woody rhizomes; slender to rather stout and woody culms, sometimes rooting at the lower nodes, short in dry but tall in moist situations; narrow leaf-blades, mostly 0·5–2 cm. wide; loose rather thin panicles 15–30 cm. long, 5–15 cm. wide; the elliptic-lanceolate to subelliptic, acute to acuminate sessile spikelets 5–6·2 mm. long, 1·5–2·2 mm. wide, more or less densely hairy, often with awns 10–14 mm. long; and the rather thin subcoriaceous glumes, the lower one very finely keeled and narrowly margined, the keels without or with only obscure minute teeth. *Sorghum controversum* differs from *S. halepense* and *S. miliaceum* in the more acuminate tip of the usually densely hairy sessile spikelets, the thinner subcoriaceous glumes, the lower one entire or obscurely and very minutely toothed near the apex, and from *S. propinquum* in the more slender culms, narrower leaves and larger, often awned, sessile spikelets.

Distribution and utility

This species is apparently confined to eastern and southern India, extending from Bengal province southwards through Bihar and Orissa to Madras province. Its utility is probably comparable with that of *S. halepense* as regards size and foliage, but little information is available at present as to its usefulness under cultivation, as hitherto it

has probably been treated as a form or variety of that species. *S. controversum* seems to succeed best under moist shady conditions, and when growing on moist river banks it often sends out adventitious roots at the lower nodes. In dry soils or when subject to drought, it tends to become dwarf and stunted. It would appear to require a tropical climate in order to succeed.

In the specimens enumerated below those with awned sessile spikelets are distinguished by an * immediately after the name or number of the collector.

INDIA. Bengal: Botanic Gardens, Calcutta, *Wallich Herbarium* 8778H! Monghyr, *Mokim* 1417! Bihar and Orissa: without precise locality, *Haines* 706 *! S 706 *! Karlapat and Lanigarh, Kalahandi State, *Mooney* 1189 *! 1736 *! Madras: Tapeswarani, Godaveri district, *Bourne* 3270 *! *Gamble* 15,780 *! at 1067 m., *Shevaroy*! Bellary district, *Brougham* *! Travancore, Countalbum, *Ramon Rao* 2111! Coimbatore, Imperial Dep. Agric. India, *Janaki Ammal* 1205 *! Ayinigira Delta, Geddesol, 1371 m., *Cherian Jacob* 356 *! Ramandrug and South Arcot district, *Madras Herb. S. India* 14,383 *! 17,860 *!

Several of the above specimens are damaged by '*Smut Disease*'. In such cases the sessile spikelets are usually awnless. They include *Mokim* 1417 and *Shevaroy*. A specimen from Bombay Reversing Station, Hull Ghat, 460 m., *Wroughton* 34, damaged by the same disease, may also belong to this species.

Hackel (in *DC., Monogr. Phan.*, **6**, 502, 1889) cited *Andropogon laxus* Roxb. (*Fl. Indica*, **1**, 275, 1820) and *A. controversus* Steud. (*Synops. Pl. Glum.* **1**, 391, 1854) in synonomy under *A. sorghum* (Linn.) var. *halepensis* (Linn.); and Piper (in *Proc. Biol. Soc. Wash.* **28**, 28, 1915) cited them in synonomy under *A. halepensis* (Linn.) *miliformis*. I think, however, that although this group belongs to the subsection *Halepensia* it is best kept as a separate species as originally described by Roxburgh.

4. **Sorghum propinquum** (Kunth) Hitchc.

Andropogon affinis J. S. Presl, in C. B. Presl, *Rel. Haenk.* **1**, 343, 1830, is the earliest name known for this species, which was described from specimens collected by Haenke in Luzon, one of the Philippine Islands.

A. propinquus Kunth, *Rev. Gram.* **1**, Suppl. 40, 1830, and *Enum.* **1**, 502, 1833, is based on *A. affinis* J. S. Presl, but the specific name was changed because it was invalidated by the older *A. affinis* R. Br., *Prod. Nov. Holl.* **1**, 201, 1810.

Sorghum propinquum (Kunth) Hitchc. in *Lingnan Sci. J.* **7**, 249, June 1929, is based on *Andropogon affinis* J. S. Presl.

Although I have not been able to see any of the specimens collected by Haenke, I have examined much material from the Philippine Islands, including *Loher* 1806 and 1807 from Luzon Island, as well as other specimens in Kew Herbarium identified by Piper as belonging to this species.

DESCRIPTION

A tall perennial, loosely tufted, with a few stoutish rhizomes often 15–30 cm. long and 3–4 mm. wide. *Culms* mostly 2–3 (rarely 5) m. high, 1–3 cm. wide near the base, sometimes branched above. *Leaves* 15–26; blades linear, from a broad somewhat clasping base, tapering upwards to the acuminate tip, 0·3–1 m. long, mostly 3–5 cm. wide, with the stoutish mid rib prominent below. *Panicles* large, loose, oblong to elliptic-oblong, 5–10 (rarely 15) cm. wide, 20–60 cm. long; branches slender, suberect or slightly spreading above, 1–4 from each node, the lower often 15–20 cm. long and exceeding half the length of the panicle, usually bare of spikelets for 1–5 cm. from the base. *Racemes* slender, fragile, crowded, 1- to 5-noded, mostly 1–2 cm. long; internodes and pedicels slender, 2·5–4 mm. long, sparsely to moderately ciliate with whitish to fulvous hairs about 0·5 mm. long. *Sessile spikelets* elliptic-lanceolate or narrowly elliptic, abruptly acute

with a short fine point, 3·8–5 mm. long, 1·2–2 mm. wide, narrowed below to about 0·5–0·8 mm. near the callus; sparsely strigose with whitish to fulvous hairs at the base, sides, and above the middle, straw-yellow to cream-colour with 3–4 delicate nerves visible between the keels of the lower glume when young, at length becoming tawny to mahogany red, blackish brown, or black; usually awnless; callus moderately to sparsely bearded. *Glumes* subcoriaceous to thinly crustaceous in the lower half, somewhat membranous above; lower usually 9- to 11-nerved, finely keeled in the upper third, not or only obscurely winged, with the keels tapering almost imperceptibly into the hyaline tip or rarely ending in very minute teeth, very finely and shortly rigidly ciliolate on the keels; upper 7-nerved, with 2 on each side of the median nerve usually somewhat short, somewhat scabrid on the keel in the upper fourth. *Lemmas* thinly ciliate about the middle or in the upper two-thirds; lower elliptic-oblong, 3·5–4·5 mm. long; upper ovate to elliptic-ovate, about 3 mm. long, entire and acuminate or minutely notched to 0·5 mm. deep and with a very small mucro (rarely a short awn), usually 1-nerved. *Anthers* 2–2·5 mm. long. *Grains* obovate to obovate-elliptic, 1·5–1·8 mm. long, 1–1·2 mm. wide, reddish brown to blackish purple, embryo-mark often obscure. *Pedicelled spikelets* usually ♂, 4–5·5 mm. long, straw-yellow to pale purplish; glumes almost membranous, lower 8- to 9-nerved, upper 5- to 7-nerved; lemmas well developed; anthers 1·5–2·5 mm. long.

Diagnostic characters and affinities

Sorghum propinquum is distinguished by its few thick rhizomes; tall stout culms, 1–3 cm. wide near the base; numerous leaves with broad blades mostly 3–5 cm. wide; large loose panicles; small narrow acute sessile spikelets, almost elliptic in outline, 3·8–5 mm. long, 1·5–2 mm. wide, usually awnless; the thin glumes, subcoriaceous below and almost papery above the middle; and rather large anthers in comparison with the size of the spikelets. It is separated from *S. controversum* by its stouter culms, wider leaf-blades, and smaller, usually awnless, sessile spikelets. It differs from *S. miliaceum* in the more acute tip of the sessile spikelets and the thinner glumes, with the lower one very finely keeled and not distinctly 3-toothed at the tip.

Distribution and utility

This species has the most easterly distribution of the wild Sorghums belonging to the section *Eu-Sorghum*. It is common in many parts of the Philippine Islands, where the type specimens were collected, and it is also found on many of the islands of south-east Asia, including Palau Islands, the Moluccas, Borneo, Sarawak, and the Malay Islands, as well as on the mainland of southern China, the Malay Peninsula, and Siam. It is also found in southern India and Ceylon, where it may have been introduced. With its tall stout culms, broad leaves, and large panicles, it has the appearance of being much more of a jungle grass than *Sorghum halepense*, resembling *S. miliaceum* in its robustness.

According to Piper (in *Proc. Biol. Soc. Wash.* **28**, 30, 1915) seeds from Manila, Luzon Island, were introduced into the United States, where under cultivation *S. propinquum* was found to resemble the cultivated grain Sorghums in its coarse stems and wide leaves. It also required a long time to reach maturity, for at Biloxi, Missouri, 2-year-old plants did not bloom until the end of October, and at Washington, D.C., the plants had not bloomed before they were cut down by frost, but the rootstocks survived the winter.

It is probably on account of its lateness in maturing, coupled with its thick culms, which would be difficult to cut with machinery, that this species does not appear to have received much attention as a fodder-crop for feeding to stock, in spite of the abundance of its broad leaves. There would also be some difficulty in harvesting the seed, as the racemes are very fragile when mature and a large proportion of the spikelets would probably fall before being harvested.

(i) Var. **propinquum**

Var. **propinquum** is based on *Andropogon propinquum* Kunth, *Rev. Gram.* **1**, Suppl. 40, 1830 and *Enum. Pl.* **1**, 502, 1833, which is based on *A. affinis* J. S. Presl, in C. B. Presl, *Rel. Haenk.* **1**, 343, 1830.

A. sorghum subsp. *halepensis* var. *propinquus* (Kunth) Hack. in *DC., Monogr. Phan.* **6**, 503, 1889, excluding Trimens specimen from Ceylon, has the same basis and is included in this variety.

A. halepensis propinquus (Kunth) Piper in *Proc. Biol. Soc. Wash.* **28**, 29, 1915, rests on the same foundation and is also included here.

This variety has small sessile spikelets 3·8–4·5 mm. long, and 1·2–1·8 mm. wide. Its distribution is mainly east of Siam.

China. Canton: *Hance* 4879! *McClure* 9138! Kwantung: *McClure* 9985! Taipu (Taifu): *Ford* 484! Hainan Island: *Henry* 8295! Paak Po Shan, Toam-chau district (Lignan University 16,236) *Tsang Wai-Tak* 737!

Philippine Islands. Luzon Island: *Elmer* 8287! *Cuming* 569! *Loher* 1806! 1807! *Merrill* 1468! *Ramos* 13,609! Mindanao Island: *Copeland* 466! *Weber* 1015! Balabac Island: *Vidal* 3996! Without precise locality, *Loher* 7169! 7209!

Borneo. Bandjarmassin, *Motley* 444! Sarawak State: *Beccari* 3924! *Clemens* 21,308!

Moluccas. Ceram Island: *Kornassi* 448! Buru Island: *Riedel*!

Malay Peninsula. Pahang: Sungei Jelei, *Machado* 11,529!

Palau Islands. Without precise locality, *Lederman* 14,284!

(ii) Var. **siamense** (Piper) Snowden

Var. **siamense** (Piper) Snowden, stat.nov., is based on *Andropogon halepensis siamensis* Piper.

A. halepensis subsp. *siamensis* Piper in *Proc. Biol. Soc. Wash.* **28**, 30, 1915, is based on specimens collected in Siam, the type being *Kerr* 2156 in Kew Herbarium.

This variety has sessile spikelets 4·5–5 mm. long, and 1·8–2 mm. wide. It is found from Siam westwards to southern India and Ceylon.

Siam. Near Kampang, 106 m., growing in pampas along the banks of Mei Ping River, *Kerr* 2156! Pak Bawag, *Kerr* 2006! Bangkok, *Kerr* 4358! Maneron, Chainat, 50 m., *Kerr* 19,671!

Cambodia. Phnom Penk (Oct. 1878) *Godefroy-Lebeuf* 83!

India. Madras: Kodaikanal Ghat and Poombari, *Bourne* 1042! 1896! Tadagam Hills, Coimbatore district, *Fischer* 2693! Without precise locality: *Anamallays*! *Jacob* 17,273! *Wallich Herbarium* 8778D (i).

Jacob's specimen is a very small piece of young material.

Ceylon. Without precise locality, *Thwaites* C.P. 2484!

Regarding *Sorghum affine* A. Camus, in Lecomte, *Fl. Gen. Ind. China*, **7**, pt 2, 321, 1922, it is to be noted that this is not the same as *Sorghum affine* Kuntze, *Rev. Gen. Pl.* p. 791, 1891, which is based on *Andropogon affine* R.Br., *Prod.* **1**, 201, 1810, and has since been named *Dichanthium affine* (R.Br.) A. Camus in *Bull. Mus. Hist. Nat. Paris*, **27**, 548, 549, 1921.

Subsection Arundinacea, series Spontanea Snowden
(In *Kew Bull.* p. 223, 1935)

5. **Sorghum virgatum** (Hack.) Stapf

Andropogon sorghum var. *virgatus* Hack. in *DC., Monogr. Phan.* **6**, 504, 1889, is the basis of this species, which is founded on specimens from Egypt and the Anglo-Egyptian Sudan. Of those cited by Hackel I have seen *Kotschy* 173 and *Schweinfurth* 529 and 538.

Sorghum virgatum (Hack.) Stapf in Prain, *Fl. Trop. Afr.* **9**, 111, 1917, is based on *Andropogon sorghum* var. *virgatus* Hack.

Description

A loosely tufted annual 30–150 cm. high. *Culms* slender, mostly 3–6 mm. wide, often with suberect branches from the lower and middle nodes. *Leaves* few; blades narrow, usually 5–15 mm. but sometimes 20 mm. wide, the longer ones attenuated towards the base, with the mid rib stout in robust specimens. *Panicle* very narrow, oblong or elliptic-oblong, 15–60 cm. long, mostly 1–5 cm. wide; branches very slender, erect or suberect, the lower 5–15 cm. long, bare for 1–5 cm. from the base. *Racemes* fragile, few- to 7-noded, up to 4 cm. long; internodes 4–5 mm. long, ciliate with whitish hairs 1–2 mm. long, pedicels similar or a little shorter. *Sessile spikelets* narrowly lanceolate, acute, 6·5–7 mm. long, 2–2·5 mm. wide, pale straw-colour or at length cream to buff yellow, with a few greenish nerves visible above the middle of the lower glume, rarely with purplish colouring, becoming somewhat glossy when mature; callus moderately to densely bearded. *Glumes* coriaceous from near the base to the middle or somewhat above the middle, then subcoriaceous to papery; lower with 11–13 primary nerves, the keels evident from about the middle, narrowly marginate and spinulously ciliolate in the upper third, terminating in minute teeth below the short hyaline tip, generally sparsely strigillose or at length almost glabrous; upper with 7 primary nerves, keeled above the middle, scabrid in the upper third otherwise almost glabrous except for the long-ciliate hyaline margins. *Lemmas* thinly long-ciliate; lower elliptic-oblong, about 5 mm. long; upper ovate-elliptic, 3·5–4 mm. long, with the lobes 0·5–1 mm. deep and a slender awn from the sinus 8–16 mm. long. *Anthers* 2·5–3 mm. long. *Grains* narrowly obovate-elliptic, 2·5–3 mm. long, 1·5–2 mm. wide, reddish brown, embryo-mark distinct. *Pedicelled spikelets* usually ♂, but sometimes reduced, 6–7 mm. long, readily deciduous; lower glume 9-nerved, upper 7- to 8-nerved; anthers about 2 mm. long.

Diagnostic characters and affinities

The long very narrow panicle, with its branches suberect and keeping near to the rhachis, combined with the narrow lanceolate spikelets 6·5–7 mm. long, furnished with long slender awns, generally suffice to enable this species to be distinguished from its nearest relative, *S. lanceolatum*. The latter has a broader panicle as well as wider lanceolate sessile spikelets with stouter awns. When the panicles of *S. virgatum* have been disarranged and the branches spread out, as sometimes happens in pressing and mounting the specimens, they lose their characteristic shape. Both the panicles and the spikelets are usually of a pale straw colour to cream or buff, and it is only rarely that they become tinged with mahogany or brownish purple colour.

Distribution and utility

From the specimens at present available it would appear that the natural distribution of *S. virgatum* is mainly confined to the hotter and drier districts of Egypt and the Anglo-Egyptian Sudan. Chiovenda (in *Fl. Somali*, **2**, 438, 1932) also records it from the Juba province of Italian Somaliland. A poor specimen in the Kew Herbarium, however, *Cieferi* 159, collected in the same province, and from which all the racemes have fallen, has hairy spikelets with stoutish awns like those of *S. lanceolatum*, and it is possible that some of the other specimens from Juba province may belong to this latter species.

S. virgatum was introduced from Egypt into Algeria, where it was grown for fodder under the name of Sorgho Menu. It was recommended by Trabut (in *C.R. Acad. Agric. Fr.* 1916) as a small Sorghum suitable for cultivation in dry regions. Piper (in *Proc. Biol. Soc. Wash.* **28**, 33, 1915) states that seed of it obtained from Trabut was introduced into the United States, where it was grown for some years under the name of Tunis Grass. Under cultivation in the United States it behaved purely as an annual and it was found to cross naturally with *S. sudanense* (Piper) Stapf, and the cultivated sweet-stemmed

variety known as Amber [a variety of *S. dochna* (Forsk.) Snowden]. Among early references to its cultivation in the United States under the name of Tunis Grass are those of Oakley in 1912 (*U.S. Dep. Agric. Year Book*, pp. 499–501) and Vinall in 1914 (*Farmers' Bull. U.S. Dep. Agric.* no. 605, p. 4). The slender culms, narrow leaves, and fragile racemes, which break up readily and allow the fruiting spikelets to fall so easily at maturity, tend to detract from the usefulness of this species under cultivation and it has been superseded in most districts by taller species with more abundant foliage. Most of the specimens enumerated below have been found in or near cultivated lands, often in sandy soils, but sometimes in irrigated lands.

EGYPT. Near Cairo: Talbia, and the Pyramids, *Acherson* 316! *Bové* 268! 269! 365! *Bolland* (July 1912)! *Keller* 428! *Meinertzhagen*! *Shabetai* 7! Ismailia, Zagazig, and Siût: *Muschler* (Dec.–Mar. 1904–5)!

ANGLO-EGYPTIAN SUDAN.[1] Between Dongola and Meru, *Bromfield* 32! Between Khartoum and Berber, *Schweinfurth* 529! 538! Kordofan, *Kotschy* 173! Khartoum, *Johnson*! *Aylmer* 322! 408! Without precise locality, *Punter*!

Vern. name. Garawi.

SOUTH AFRICA. Bechuanaland: Mafeking, *Nat. Herb. Pretoria* H. 11,074!

Vern. name: Tunis Grass.

The specimen from Mafeking is mixed with a *Sorghum* sp. near *S. mellitum* var. *australe* Snowden.

WEST AUSTRALIA. Swan River, *Drummond*!

The specimen from West Australia was cited by Bentham (in *Fl. Aust.* **7**, 540, 1878) under *S. halepense* Pers. It agrees well with a specimen from near Cairo, Egypt (*Bové* 268, collected in 1830), and it seems possible that Drummond's label may have been wrongly attached to the specimen.

Hackel (in *DC., Monogr. Phan.* **6**, 504, 1889) cites specimens from Upper Egypt: at Damietta, *Ehrenberg*; Alexandria, *Wichura*; and Suez, *Kotschy It. Syr.* 882, as well as from the Oasis of Thebes, *Unger*; in addition to those given above. He also cites a specimen from Senegal, *Perrottet* 928; but according to Stapf (in Prain, *Fl. Trop. Afr.* **9**, 111, 1917) this is probably *S. lanceolatum*. Stapf also states that, according to the specimens in Forskal's herbarium in Copenhagen, *Holcus exiguus* Forsk. (in *Fl. Aeg.-Arab.* p. 174, 1775) is *Sorghum halepense* (Linn.) Pers. Piper would therefore appear to have been mistaken in identifying Forskal's species with that of *Andropogon sorghum* var. *virgatus* when describing his *A. sorghum exiguus* (in *Proc. Biol. Soc. Wash.* **28**, 32, 1915).

6. **Sorghum lanceolatum** Stapf

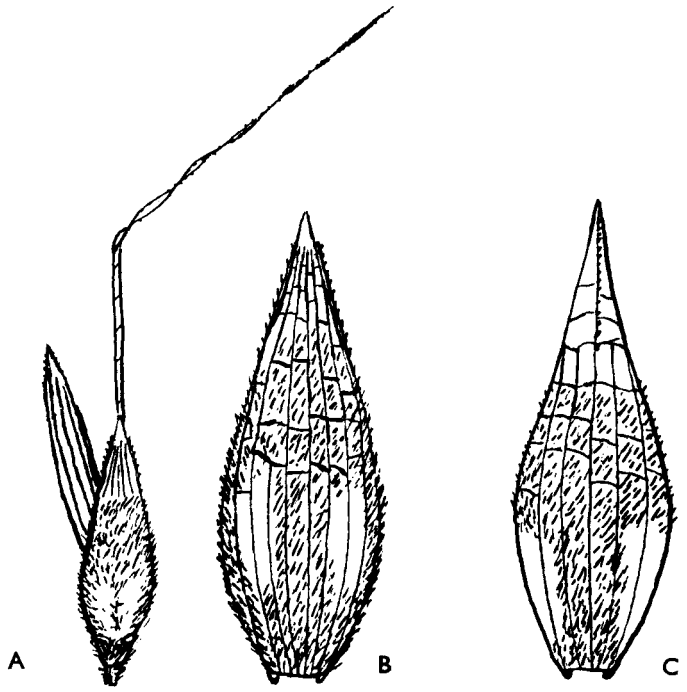
Sorghum lanceolatum Stapf in Prain, *Fl. Trop. Afr.* **9**, 112, 1917. This species was described by Stapf from specimens in Kew Herbarium, *Dalziel* 293, collected in the Katagum district of Northern Nigeria, and *Broun* 1473, from the Upper Nile province of the Anglo-Egyptian Sudan.

DESCRIPTION

An annual or short-lived perennial up to 2·5 m. high. *Culms* slender to somewhat stout, 5–10 mm. wide, simple or branched above. *Leaves* many; blades up to 50 cm. long, somewhat narrow, generally not exceeding 2 cm., but sometimes up to 3 cm. wide, often with a rather broad rounded base, the larger ones with the mid rib prominent and acutely keeled below. *Panicle* lanceolate to ovate-oblong, 20–40 cm. long, up to 15 (rarely 20) cm. wide; branches rather slender and flexuous, soon spreading, the lower 10–15 (rarely 25) cm. long, well furnished with spikelets almost to the base. *Racemes* fragile, 2- to 4-noded, up to 3 cm. long; internodes slender, 3–5 mm. long, ciliate with whitish hairs 1–1·5 mm. long, pedicels similar, or a little shorter. *Sessile spikelets* lanceolate, shortly

[1] The former Anglo-Egyptian Sudan is now known as Sudan.

acuminate, 6–8 mm. long, 2–3 mm. wide, cream to buff yellow with a few greenish nerves visible in the tips of the glumes, often turning reddish to maroon when mature, somewhat whitish strigillose or at length almost glabrous; callus copiously bearded with hairs about 1 mm. long. *Glumes* coriaceous below but thinner above the middle; lower 11- to 13-nerved, with the keels distinctly evident in the upper half, obscurely or not winged, finely spinulously ciliolate, and terminating with obscure or very minute teeth below the hyaline tip; upper 7-nerved, sharply keeled and somewhat scabrid in the upper fourth. *Lemmas* thinly long-ciliate; lower lanceolate to elliptic-lanceolate, about 6 mm. long;



Sorghum lanceolatum Stapf. A, sessile and pedicelled spikelets; B, lower glume; C, upper glume, exterior view. A, × 5; B and C, × 10. (From *Trapnell* 920.)

upper ovate-elliptic, 4–4·5 mm. long, 2-lobed to about 1 mm. deep, awn stoutish, 5–16 (rarely 20) mm. long. *Anthers* 3·5–4 mm. long. *Grains* obovate-elliptic to obovate-oblong, 3–3·5 mm. long, 2–2·5 mm. wide, reddish to brownish, with the embryo mark somewhat obscure. *Pedicelled spikelets* 6–8 (rarely 10) mm. long, often ♂ but sometimes reduced, deciduous; lower glume 9- to 11-, upper 5- to 7-nerved; anthers 3–4 mm. long.

Diagnostic characters and affinities

In its characteristic features *S. lanceolatum* is somewhat intermediate between *S. virgatum* Stapf and *S. vogelianum* Stapf. From the former it differs in its stout tall culms, larger spreading panicle with flexuous branches, wider sessile spikelets with stoutish awns, and a greater tendency towards reddish or purplish colouring at maturity. It differs from *S. vogelianum* in its smaller and narrower lanceolate sessile spikelets more finely spinulously ciliolate on the keels of the lower glume, and from the typical specimen, collected by *Vogel*, in its narrower leaves. It should be noted, however, that some of the less robust specimens of *S. vogelianum* have rather narrow leaves and differ from *S. lanceolatum* mainly in the wider elliptic- to oblong-lanceolate sessile spikelets coarsely spinulously ciliolate on the keels of the lower glume.

Distribution and utility

S. lanceolatum is most frequent in the southern provinces of the Anglo-Egyptian Sudan, but its distribution also extends westwards through Nigeria and the French Sudan to Senegambia. Specimens have also been collected in northern Uganda and in the Juba province of Italian Somaliland. It has also been introduced into the United States of America, where many plants have been raised from seed collected by Shantz in the Anglo-Egyptian Sudan, but its cultivation in that country does not appear to have passed the experimental stage. It has also been introduced for trial in Northern Rhodesia. A few specimens, collected in Northern Nigeria near fields of cultivated grain Sorghums, have tough racemes and appear to have resulted from intercrossing between the cultivated Sorghums and *S. lanceolatum*. Although it has stouter and more leafy culms that would tend to make it more useful for fodder than *S. virgatum*, it does not appear to have been cultivated for that purpose. It probably requires a warmer climate than some of the Sorghums that are generally grown to feed live-stock. Most of the specimens from Africa that are given below were found growing near to rivers or in swampy lands, but a few were collected in or near to cultivated lands and one in very dry cotton fields.

Senegambia. Without precise locality, *Heudelot* 544! 654!

Both these specimens are somewhat immature.

French Sudan. El Oudladji, *Chevalier* 43,947!

Nigeria. Northern Provinces: Katagum district, *Dalziel* 293! Southern Provinces: Kwarre, *Sampson* 27! Onitsha, *Jones* 6277!

Vern. name: Dawar Rafi.

The following specimens with tougher racemes and rather wider sessile spikelets have probably resulted from intercrossing between this species and a cultivated grain Sorghum such as *Sorghum guineense* Stapf: Kwarre, *Sampson* 25! 26! Onitsha, *Jones* 6887!

Anglo-Egyptian Sudan. Upper Nile province: White Nile, Kio Rubber Plantation, *Broun* 1473! Mongalla province:[1] Malakal, *Shantz* 966! 967! 968! *Simpson* 7440! Taufikia, *Shantz* 959! mouth of Sobat River, *Shantz* 962! *Evans Pritchard* 32! Rejaf, *Shantz* 947! 948! 949! 950! Nimule, *Shantz* 895! 899! Tendelai, Gash Delta, *Andrews* 10! s.n.!

Two poor specimens collected at Mongalla and Nimule, *Simpson* 7600! 7568! probably belong here. Also a vigorous specimen with rather larger spikelets than usual, *Myers* 7326! collected on the River Sire, Meridi district.

Vern. names: Adar (Arabic); Abet (Dinka); Obaro (Anuak); Titavunde (Zande); Ngorinye-Lokima (Kakwa); Neibel (Mberedi); Nuku Su (Mve Gumba).

In addition to the above, there are a large number of specimens from plants grown mainly in greenhouses at experimental stations in the United States from seed collected by *Shantz* in the localities named above. These were sent to Kew by the United States Department of Agriculture Sorghum Herbarium. The most typical are S.P.I. numbers: 02093! 51995! 51997! 51998! 52002! 52004! 52006! 52021! 52026! 52028! 52031! 52032! 52035! 52037! 52039! 52042! 52045! 52046! 52051! 52068! 52069! 52073! 52074! 52077! 52080! 52081! 52082! 52083! 52085! 52094! 52098! 52101! 52102! 52103! 52109! 52114! 52116! 52117! 52118! 52155! 52159! 52160! 52161! 52163! 52166!

Most of the sessile spikelets have fallen off the specimens and are enclosed in envelopes attached to the mounting sheets.

The following have unusually wide leaves, which may be due either to the conditions under which the plants were grown or in some cases to intercrossing with wider-leaved species: S.P.I. numbers: 52016! 52017! 52018! 52019! 52020! 52022! 52023! 52024! 52049! 52050! 52093! 52097! 52099! 52100! 52104! 52105! 52107! 52108! 52110! 52112! 52113! 52158! 52164!

[1] Mongalla province is now known as Equatoria.

ITALIAN SOMALILAND. Juba province, *Cifeiri* 159!
This is a poor specimen, with all the spikelets fallen from the panicle.
UGANDA. Chua district, at Kitgum, *Thomas* 4349!
NORTHERN RHODESIA. Mazabuka, under trial for fodder purposes, *Trapnell* 920!

7. **Sorghum vogelianum** (Piper) Stapf

Andropogon sorghum vogelianus Piper in *Proc. Biol. Soc. Wash.* **28**, 34, 1915, is the basis of this species. The type specimen cited by Piper is *Vogel* 11 in Kew Herbarium. It was collected on the banks of the Nun River, Southern Nigeria. Piper mentions other specimens but states that although very similar none of them matches Vogel's plant.

Sorghum vogelianum (Piper) Stapf in Prain, *Fl. Trop. Afr.* **9**, 116, 1917. Based on *Andropogon sorghum vogelianus* Piper.

DESCRIPTION

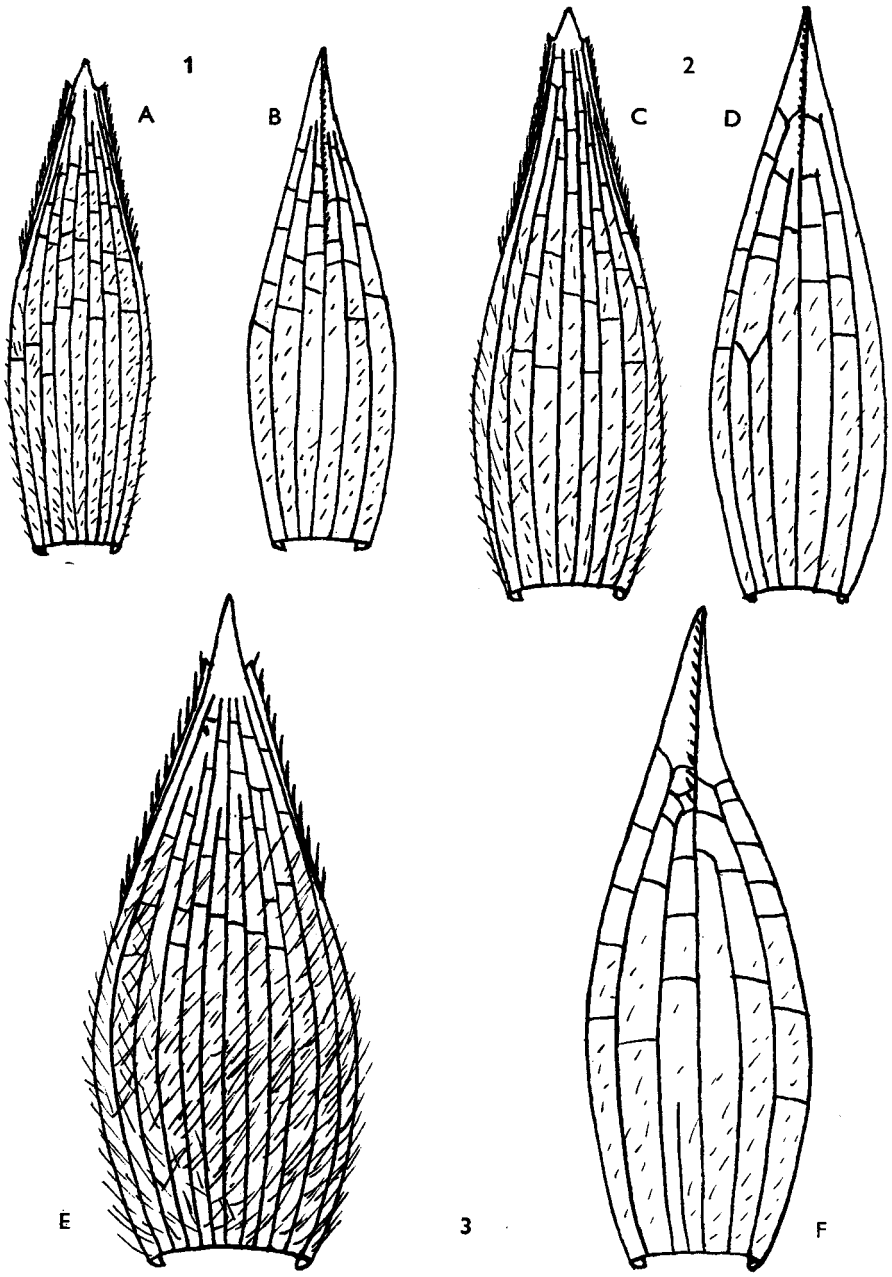
A tall loosely tufted annual, or sometimes perennial, 2–5 m. high. *Culms* stout, up to 1 cm. wide, usually simple. *Leaves* many; blades up to 75 cm. long, 3–7 cm. wide in vigorous specimens, but only 1–2 cm. wide in depauperate specimens, with a broad rounded base, tapering upwards to an acuminate tip. *Panicle* large and loose, elliptic or pyramidal, 15–45 cm. long, 5–25 cm. wide; branches obliquely ascending or spreading, slender and flexuous except near the villous base, the lower 5–20 cm. long, furnished with spikelets throughout, or bare for 1–5 cm. *Racemes* fragile, 2- to 7-noded, up to 3·5 cm. long; internodes slender, 3–4 mm. long, densely ciliate with fulvous or rufous hairs 1–1·5 mm. long; pedicels similar, 3–5 mm. long. *Sessile spikelets* elliptic- to oblong-lanceolate, acuminate, 8–9 (rarely 7–10) mm. long, 2·5–3·5 mm. wide, straw colour to buff yellow or at length tawny to red or black; awned or awnless; callus densely bearded with hairs about 1 mm. long. *Glumes* coriaceous to beyond the middle, thinner above with the greenish nerves visible; lower with 12–15 primary nerves, a few cross nerves near the middle, 2-keeled from the middle upwards with the sharp keels narrowly winged and coarsely spinulously ciliate, terminating in minute teeth near the tip, hairy with fulvous to rufous hairs, especially at the base and sides, or at length glabrescent on the back; upper with 7 primary nerves, a few cross-nerves in the upper two-thirds, scabrid on the keel in the upper third, glabrous or sparsely hairy. *Lemmas* densely ciliate; lower elliptic-lanceolate, 7–8 mm. long; upper ovate, 4–5 mm. long, 2-lobed to 1·5 mm. deep, with an awn 8–16 mm. long, or subentire and mucronate or with a short bristle. *Anthers* 4–5 mm. long. *Grains* obovate-elliptic, about 3·5 mm. long and 2 mm. wide, tawny to dark-red. *Pedicelled spikelets* ♂ or sometimes neuter, 7–9 mm. long, at length deciduous; lower glume 10- to 11-nerved, upper 5- to 7-nerved; anthers about 4 mm. long.

DIAGNOSTIC CHARACTERS AND AFFINITIES

S. vogelianum is most closely related to *S. lanceolatum*, but the typical specimens are readily separated from the latter species by the wide leaves, very large panicles, and the larger sessile spikelets. Some specimens, however, have rather narrow leaves and small panicles, due either to unfavourable conditions of growth, or because they have been collected from tiller-shoots or from secondary branches. These can generally be distinguished from *S. lanceolatum* by the larger elliptic- to oblong-lanceolate sessile spikelets with long coarse spinulous cilia on the keels of the lower glume.

DISTRIBUTION AND UTILITY

The distribution of this species, as at present known, is limited to Nigeria and the Cameroons, but it is possible that it may extend into some of the adjacent territories of West Africa. The material available at Kew is very small and there is no information as



(1) *Sorghum virgatum* (Hack.) Stapf. A, lower glume; B, upper glume. (From *Schweinfurth* 529.) (2) *S. lanceolatum* Stapf. C, lower glume; D, upper glume. (From *Dalziel* 293.) (3) *S. vogelianum* (Piper) Stapf. E, lower glume; F, upper glume. (From *Vogel* 11.) All × 10, exterior view.

to the plants being used for any special purpose. As it grows in a region where the climate is hot and humid, it is unlikely to prove suitable for cultivation as fodder in most of the countries devoted to stock-raising on a large scale. Most of the plants listed below were found growing on the banks of rivers, and there is no evidence that they frequent cultivated lands.

NIGERIA. Northern Provinces: without precise locality, *Lely* 778! Southern Provinces: on the banks of the Nun River entrance to the River Niger, *Vogel* 11! Idu, banks of the Eugenni River, *Holland* 153! Makurdi, north bank of river, *Sampson* 37!

CAMEROONS. By the Cameroon River, *Mann* 2109!

In addition to the above Stapf cites the following: Southern Nigeria, Lau and Amar, by the Benue River, *Macleod* 49, 60, 62, 65; Oban, *Talbot* 846; Cameroons, Karnak Logome, *Macleod* 157.

Among the specimens mentioned by Piper under his *Andropogon sorghum vogelianus* (in *Proc. Biol. Soc. Wash.* **28**, 34, 1915), but excluded by Stapf (in Prain, *Fl. Trop. Afr.* **9**, 116, 1917), two in Kew Herbarium, *Mahon*, collected in Uganda in 1902, and *Kirk*, collected below Mazzaro on the Zambesi River in 1860, are now referred to *Sorghum verticilliflorum* Stapf. The specimens in Herb. Berol. cited by Piper have not been seen by me, but those from Tanganyika Territory (German East Africa) are unlikely to belong to *S. vogelianum*, which is a West African species. The specimen cited by Piper from Korbo, on the Chari River, near Lake Chad, *Chevalier* 9397, is within reasonable range of the area of distribution and is probably a form of *S. vogelianum*.

8. **Sorghum aethiopicum** (Hack.) Rupr. ex Stapf

Andropogon sorghum var. *aethiopicus* Hack. in *DC., Monogr. Phan.* **6**, 504, 1889, is the foundation of this species. It was described by Hackel from plants collected by Kotschy and Schweinfurth in the Anglo-Egyptian Sudan. Of those cited by Hackel I have seen *Kotschy* 132 and 390.

Sorghum aethiopicum (Hack.) Rupr. ex Stapf in Prain, *Fl. Trop. Afr.* **9**, 119, 1917, rests on *Andropogon sorghum* var. *aethiopicus* Hack.

DESCRIPTION

An annual 0·5–3 m. high. *Culms* slender to stout, 0·5–2 cm. or more wide, simple or branched above. *Leaves* few to many; blades lanceolate to linear-lanceolate, 5–35 cm. long, 0·5–3 cm. wide, the short ones with a broad rounded and subcordate base, the longer ones somewhat narrowed towards the base, the midrib rather slender. *Panicle* narrow, linear to elliptic-oblong, 10–40 cm. long, 3–10 cm. wide, contracted or loose below, sometimes subsecund; branches usually 2–3 from each node, suberect and flexuous except near the villous base, 5–10 (rarely 20) cm. long, divided near the base or bare for 1–5 cm. *Racemes* more or less fragile, 1- to 4-noded, up to 2·5 cm. long; internodes slender, 3–5 mm. long, densely ciliate with white hairs 1 mm. long; pedicels very similar but sometimes shorter. *Sessile spikelets* elliptic- to ovate-lanceolate, acute or subacute, 6–8 mm. long, 2·5–3·5 mm. wide, pale cream to buff yellow or somewhat tawny to reddish, especially near the tips and below the middle, permanently and densely white-tomentose or sometimes becoming glabrescent on the more exposed portions, long-awned; callus beard copious. *Glumes* coriaceous almost throughout but thinner towards the tips where the nerves become visible; lower 13- to 15-nerved, the keels narrowly winged and spinulously ciliolate in the upper third, terminating in minute teeth, with the hyaline apex projecting between them; upper 7-nerved, the keel sharp and scabrid in the upper third. *Lemmas* densely ciliate; lower elliptic-oblong, 6–7 mm. long; upper ovate, 4·5–5 mm. long, 2-lobed for 1·5–2 mm. deep, awn stoutish, usually 20–30 mm. long. *Anthers* 3·5–4 mm. long. *Grains* obovate-elliptic, 2·5–4 mm. long, 1·5–2 mm. wide,

tawny to dark red, embryo-mark usually distinct. *Pedicelled spikelets* usually ♂ but sometimes reduced, 7–9 mm. long, often more or less reddish coloured, tardily deciduous; lower glume 8- to 10-nerved, upper 5- to 7-nerved; anthers 3–4 mm. long.

Diagnostic characters and affinities

S. aethiopicum is characterized by the narrow panicles of densely hairy long-awned sessile spikelets 6–8 mm. long, 2·5–3·5 mm. wide. In specimens having rather narrow spikelets it approaches near to *S. lanceolatum*, but usually it can be distinguished from it by the narrower panicle, the more densely hairy elliptic-lanceolate sessile spikelets, and the longer awns; also the leaves are generally wider in comparison with their length. Some of the less hairy specimens may resemble *S. macrochaeta* (*S. abyssinicum* Stapf non Kuntze), but the latter has a larger, wider, and looser panicle and the sessile spikelets shortly and finely hairy with usually tawny hairs, or the spikelets may be almost glabrous; the leaf-blades are also much longer and wider.

Distribution and utility

This species is widely distributed in the Anglo-Egyptian Sudan. It also extends westwards to Northern Nigeria and the French Sudan and eastwards to Eritrea and British Somaliland. A specimen has also been recorded from the Tana River region of north-eastern Kenya. A plant found growing in a nursery in Sierra Leone was probably introduced. Although *S. aethiopicum* does not appear to have been much cultivated for fodder there is evidence that it readily intercrosses with some of the cultivated grain Sorghums, especially those of the subseries *Durra*, as specimens that appear to have resulted from such cross-pollination are frequently encountered. A race that has probably arisen from cross-fertilization of this kind has been cultivated to some extent in the United States of America, under the name of *S. hewisonii* (Piper) Longley, and will be described below towards the end of this revision.

S. aethiopicum is most commonly found growing in fertile soils, often close to rivers, near cultivated lands where Sorghums and other crops are grown. It is less frequent in drier sandy or rocky places and plants growing in such habitats are usually small and have narrow sparsely branched panicles. The occurrence of dwarf and tall varieties in this species is something like that of varieties of different height frequent among the cultivated grain Sorghums. In such cases the dwarf varieties are usually preferred for cultivation as they are generally early maturing and more easily harvested.

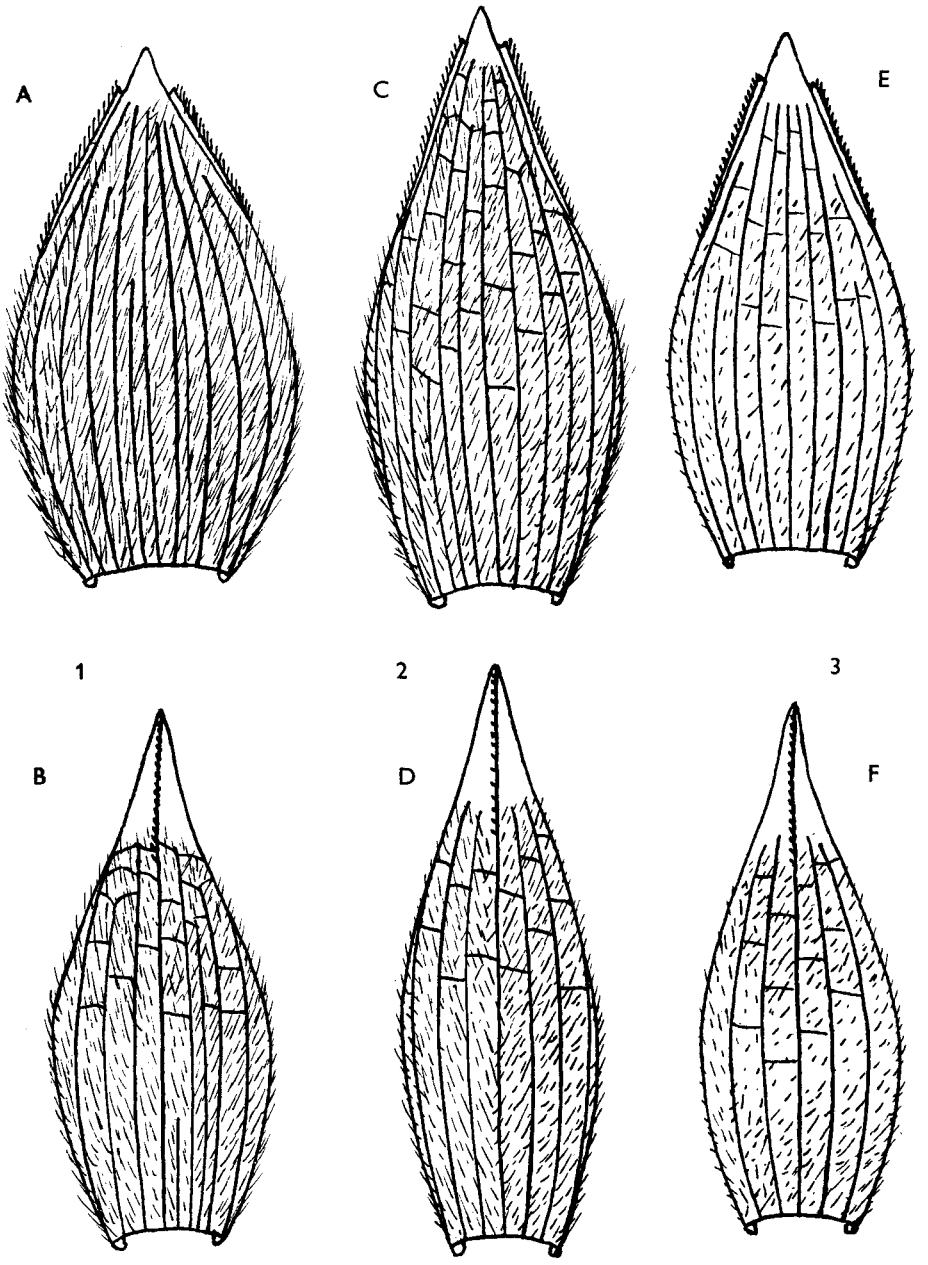
(i) Var. **aethiopicum**

Var. **aethiopicum** is based on *S. aethiopicum* (Hack.) Rupr. ex Stapf. It is described by Hackel as *Andropogon sorghum* var. *aethiopicus* subvar. *longiaristatus* in *DC., Monogr. Phan.* **6**, 505, 1889. Under it Hackel cites *Kotschy* 390, from Jebel Arash-Kol, and *Schweinfurth* 655, from Wadi Eremit. I have seen *Kotschy* 390 in Kew Herbarium.

Culms rather stout and tall, mostly 1·5–3 m. high; leaf-blades linear-lanceolate, from a somewhat narrowed base, tapering upwards to the acuminate tip, mostly 15–35 cm. long and 1·5–3 cm. wide; sessile spikelets 3–3·5 mm. wide, usually with more or less reddish tips; pedicelled spikelets also reddish.

Sierra Leone. Njala, in nursery, probably introduced, *Deighton* 772!

Anglo-Egyptian Sudan. Kordofan, Arash-Kol Mountain, *Kotschy* 390! Blue Nile, *Muriel* L. 13! Gash Delta, Tendelai and Hadeleia, *Andrews* 5! 6! 13! 16! 17! 18! Gedaref and Daysa, *Andrews* A 3273! A 3295! Jebel Maya, *Andrews* A 3307! Nagam El Dein, *Andrews* 3321! Between Abu Hasleim and Karkoj, *Andrews* A 3343! Khor Remeilo, *Andrews* A 3353!



(1) *Sorghum aethiopicum* (Hack.) Rupr. ex Stapf var. *aethiopicum*. A, lower glume; B, upper glume. (From *Kotschy* 390.) (2) *S. aethiopicum* (Hack.) Rupr. ex Stapf var. *brevifolium* Snowden. C, lower glume; B, upper glume. (From *Kotschy* 132.) (3) *S. macrochaeta* Snowden. E, lower glume; F, upper glume. (From *Schweinfurth* 1521.) All $\times 10$, exterior view.

Vern. names: Adar, Addar (Arabic, also used for *Sorghum halepense*).

The following specimens, with somewhat tougher racemes, as well as larger leaves and panicles, have probably resulted from intercrossing with cultivated races, but are best placed here: Gash Delta, Tendelai, *Andrews* 4! 8! Upper Nile province, between Buffalo Cape and Kilo 60, Bahr el Jebel, *Harrison* 40!

BRITISH SOMALILAND. Without precise locality, *Collenette* 159!

(ii) Var. **brevifolium** Snowden

Var. **brevifolium** Snowden, var.nov. Culmi gracili, pumili, fere 0·5–1 m. alti; laminae foliorum plerumque 5–10 cm. longae, 0·5–1·5 cm. latae, nonnunquam longiorae, plerumque lanceolatae, basin versus rotundatae vel subcordatae; spiculae sessiles 2·5–3 mm. latae, fere pallido-coloratae, raro apicibus pallido-rubrae; spiculae pedicellatae pariter sessilibus coloratae.

Culms slender and dwarf, mostly 0·5–1 m. high; leaf-blades usually 5–10 cm. long and 0·5–1·5 cm. wide, generally lanceolate, with a broad, rounded or subcordate, base; sessile spikelets 2·5–3 mm. wide, usually pale coloured with greenish nerves showing near the tips; pedicelled spikelets also mostly pale with greenish nerves, rarely with pale reddish colouring.

The type of this variety is *Kotschy* 132 in Kew Herbarium.

FRENCH SUDAN. Without precise locality, *Chevalier* 43,027!

NORTHERN NIGERIA. Kalkala, south-west corner of Lake Chad, *Golding* 77! This is a poor specimen.

ANGLO-EGYPTIAN SUDAN. Without precise locality, *Kotschy* 132! El Ghazalan, *Punter*! Gezira Research Farm, *Andrews* K31! Gash Delta, Tendelai and Hadeleia, *Andrews* 7! 11! 15! Gedaref, *Andrews* A3238! A3252! Nagm El Dein, *Andrews* 3322!

KENYA COLONY. Tana River province, Taneta, 762 m., *Sampson* 95!

In addition to the subvar. *longiaristatus*, Hackel (in *DC., Monogr. Phan.* **6**, 505, 1889) also described a subvar. *breviaristatus*, and cited the following specimens under it: *Kotschy* 158 from Arash-Kol, *Pfund* (in exped. Colston Herb. Berol. 560) from Darfur province, *Schweinfurth* 599 from Sagadi between Suakin and Berber, and a form with dark purple spikelets, *Marloth* 1363 from Damaraland. He also mentions as intermediate between var. *aethiopicus* and var. *virgatus* specimens from Nubia province collected by Hartmann, and as intermediate between var. *effusus* and var. *aethiopicus* a specimen from Matamma, *Schweinfurth* 1521, which he had already cited under var. *effusus* (loc. cit. 504). Of these specimens Stapf included under *S. aethiopicum* only *Schweinfurth* 599. In his footnotes to the species Stapf (in Prain, *Fl. Trop. Afr.* **9**, 120, 1917) states that *Kotschy* 158 has a rather dense panicle and broad spikelets with somewhat triangular subherbaceous tips. He suggests that it may be a cross between *S. aethiopicum* and the cultivated *S. durra*.

Piper, who apparently examined all the above specimens, states (in *Proc. Biol. Soc. Wash.* **28**, 40–41, 1915) that the two specimens collected by Hartmann are infested with 'Smut Disease' and are abnormal. He expresses the opinion that the specimen collected by Pfund may be a cultivated plant, or a hybrid with one, and considers it impossible to include it under *cordofanus* (i.e. *aethiopicus*). He is still more doubtful of the specimen collected by Marloth in Damaraland. On the other hand, Piper states that a specimen from the Anglo-Egyptian Sudan, *Broun* 1473, is very close to typical *cordofanus*. This latter specimen, however, is one of the two plants on which Stapf afterwards based his *S. lanceolatum*.

As Stapf pointed out (in Prain, *Fl. Trop. Afr.* **9**, 120, 1917) the use of the name *Andropogon sorghum cordofanus* by Piper for *Sorghum aethiopicum* was due to a mistaken identification, which may have resulted from a confusion of labels, with *Andropogon cordofanus*

Hochst. (*Kotschy* 54) which is *A. gayanus* var. *cordofanus*. Although Stapf drew attention to this mistake he inadvertently included *A. aethiopicus* Rupr. ex. Steud. (which is a synonym of *A. cordofanus* Hochst.) in the synonomy given at the end of his description of *Sorghum aethiopicum*. The latter species is a manuscript name of Ruprecht mentioned in synonomy by Hackel (loc. cit. 504) under *Andropogon sorghum* var. *aethiopicus*. The specimen collected at Matamma, *Schweinfurth* 1521, is the type of *A. sorghum abyssinicus* Piper and will be referred to again under *Sorghum macrochaeta* (*S. abyssinicum* Stapf non O. Kuntze).

9. **Sorghum macrochaeta** Snowden

Andropogon sorghum abyssinicus Piper in *Proc. Biol. Soc. Wash.* **28**, 39, 1915, was described from a specimen collected in the south-east corner of Kassala province in the Anglo-Egyptian Sudan, at Matamma near Gallabat, close to the border of Abyssinia. I have seen the duplicate of the type specimen, *Schweinfurth* 1521.

Sorghum abyssinicum Stapf in Prain, *Fl. Trop. Afr.* **9**, 118, 1917, is based on *Andropogon sorghum abyssinicus* Piper.

Sorghum macrochaeta Snowden in the *Cultivated Races of Sorghum*, p. 237, 1936. This is a change of name for *S. abyssinicum* Stapf. because the latter is invalidated by the older *S. abyssinicum* (R.Br.) O. Kuntze in *Rev. Gen.* p. 791, 1891.

Description

A tall annual or, under favourable conditions, sometimes perennial. *Culms* stout, 5–8 mm. wide at the base of the panicle, often somewhat purplish below the nodes. *Leaves* numerous; blades linear-lanceolate, from a somewhat rounded base long-tapering upwards to a fine point, up to 75 cm. long and 3–6 cm. wide, green with purplish markings, the mid rib rather stout and prominent below in the basal portion. *Panicle* obovate-lanceolate, elliptic, or oblong, loose, up to 35 cm. long and 8–15 cm. wide; branches slender, somewhat flexuous and spreading, the lower ones mostly 5–6 from a node and up to 15 cm. long, usually bare of spikelets for 1–5 cm. from the hirsute base. *Racemes* mostly 2- to 3-noded, up to 2·5 cm. long; internodes and pedicels slender, 4–5 mm. long, shortly ciliate with whitish to fulvous hairs. *Sessile spikelets* elliptic-lanceolate to elliptic-oblong, acute, 6·5–8 mm. long, 2·5–3·5 mm. wide, dull cream to buff yellow when young, with 5–6 nerves evident between the keels of the lower glume, long-awned; callus copiously bearded with hairs about 1 mm. long. *Glumes* coriaceous below the middle, subcoriaceous above; lower 11- to 13-nerved, sharply keeled from just above the middle, with the keel margins slender below but gradually widening upwards until they end in distinct minute teeth below the acute hyaline tip, covered throughout with usually fulvous hairs or becoming glabrescent on some of the more exposed portions; upper 7-nerved, sharply keeled above the middle, scabrid on the keel, sparsely hairy, ciliate on the incurved margins. *Lemmas* finely ciliate; lower elliptic-oblong, 5–6·5 mm. long; upper ovate, 4–5 mm. long, 2-lobed to 1½–2 mm. deep, awn usually 20–25 mm. long. *Anthers* 4–5 mm. long. *Grains* obovate-elliptic, 2·5–4 mm. long, 1·3–2 mm. wide, embryo-mark more or less distinct. *Pedicelled spikelets* usually ♂, 7–8 mm. long, greenish, or often tinged with reddish purple, at length deciduous; lower glume 8- to 10-nerved, upper 6- to 7-nerved; anthers 3–4 mm. long.

Diagnostic characters and affinities

S. macrochaeta is distinguished by its long wide leaves; large spreading panicle; and the elliptic-lanceolate to elliptic-oblong sessile spikelets, 6·5–8 mm. long, 2·5–3·5 mm. wide, shortly hairy or at length glabrescent, with long awns usually 20–25 mm. long. It differs from the closely related *S. aethiopicum* in its longer wider leaves, larger spreading panicle, and less hairy spikelets. It is also related to *S. arundinaceum* and *S. verticilliflorum* but may be separated from the former by the long-awned, wider and more elliptic-

oblong sessile spikelets; and from the latter by the broader leaves and somewhat larger, wider sessile spikelets with usually longer awns. The margins of the keels of the lower glume of *S. macrochaeta* usually tend to become wider upwards with more distinct minute teeth than do those of the other two species.

Distribution and utility

S. macrochaeta has been recorded in various localities from the southern part of Kassala province in the Anglo-Egyptian Sudan southwards through Mongalla province and the south-eastern areas of the Belgian Congo and the adjoining districts of Tanganyika into Northern Rhodesia. Eastwards it extends into Eritrea. According to Schweinfurth's notes on the type specimen it is a troublesome weed in cultivated lands. There is no evidence available of its cultivation for the purpose of fodder, but plants have been raised and grown experimentally in the United States of America from seed collected in the Anglo-Egyptian Sudan and the Belgian Congo. With its sturdy culms and broad leaves it has the appearance of being a useful fodder plant but it does not seem to be very abundant. It may require a hotter and more humid climate than some of the other species which are more frequently cultivated in stock-breeding countries.

The majority of the specimens listed below were found growing in alluvial soils near rivers or lakes, often in or near cultivated lands. It is evident from the number of intermediate forms between this species and cultivated grain Sorghums that it readily intercrosses with them in all the regions into which it extends.

Belgian Congo. Urua district: Lake Kisale, at Kadia, *Shantz* 596! 597! Kayombe, *Shantz* 602! Bukama, ex *U.S. Dep. Agric. Sorghum Herb. S.P.I.* 49,697! 49,698! Nionga (Nianzu?), ex *U.S. Dep. Agric. Sorghum Herb. S.P.I.* 50,008! Urundi district: *Ngano Ngano and Nyanza*, ex *U.S. Dep. Agric. Sorghum Herb. S.P.I.* 50,008! 50,790! 50,802! 50,805! 50,806! 50,807! Maniema district: Kasongo, ex *U.S. Dep. Agric. Sorghum Herb. S.P.I.* 50,079!

The following specimens raised in the United States from seed collected in Urundi district at Nyanza, although they have somewhat shorter awns, are best placed here: ex *U.S. Dep. Agric. Sorghum Herb. S.P.I.* 50,791! 50,792! 50,794! 50,796! 50,801! 50,808! F.C. I. 11,521!

Anglo-Egyptian Sudan. Kassala province: near Gallabat, *Schweinfurth* 1521! Gedaref, *Andrews* A3162! 3212! 3232! 3239! Mongalla province: Bahr el Gebel, *Simpson* 7280! Yei River, at Lado, *Sillitoe* 25! Nimule, *Shantz* 896! Rejaf, ex *U.S. Dep. Agric. Sorghum Herb. S.P.I.* 51,999! 52,033! 52,106! 52,111! 52,154! Without precise locality, *Punter*!

Andrews's specimens are unusually hairy and appear to have been grown in a very dry district.

Vern. names: Addar, Adar el Bousse (Arab.).

The following specimens with persistent sessile spikelets, shorter awns, and larger grains, appear to have resulted from intercrossing between this species and cultivated grain Sorghums: Mongalla province: Taufikia, *Shantz* 958! Mongalla and Rejaf, ex *U.S. Dep. Agric. Sorghum Herb. S.P.I.* 52,044! 52,075!

Eritrea. Without precise locality, *Terraciano et Pappi* 2355! The spikelets of this specimen are immature and rather small.

Tanganyika Territory. Unyamwezi district, Wala River, *Böhn* 101! Ugogo district, Shinyanga, near River Ninghua and other rivers, 1150 m., *Burtt* 2580!

The following specimens with tough racemes appear to be hybrids between this species and cultivated grain Sorghums: Huru Huru, *Staples* 433! Mpwapwa, *Hornby* 521! Lake Victoria, near Smith Sound, *Rounce* 282!

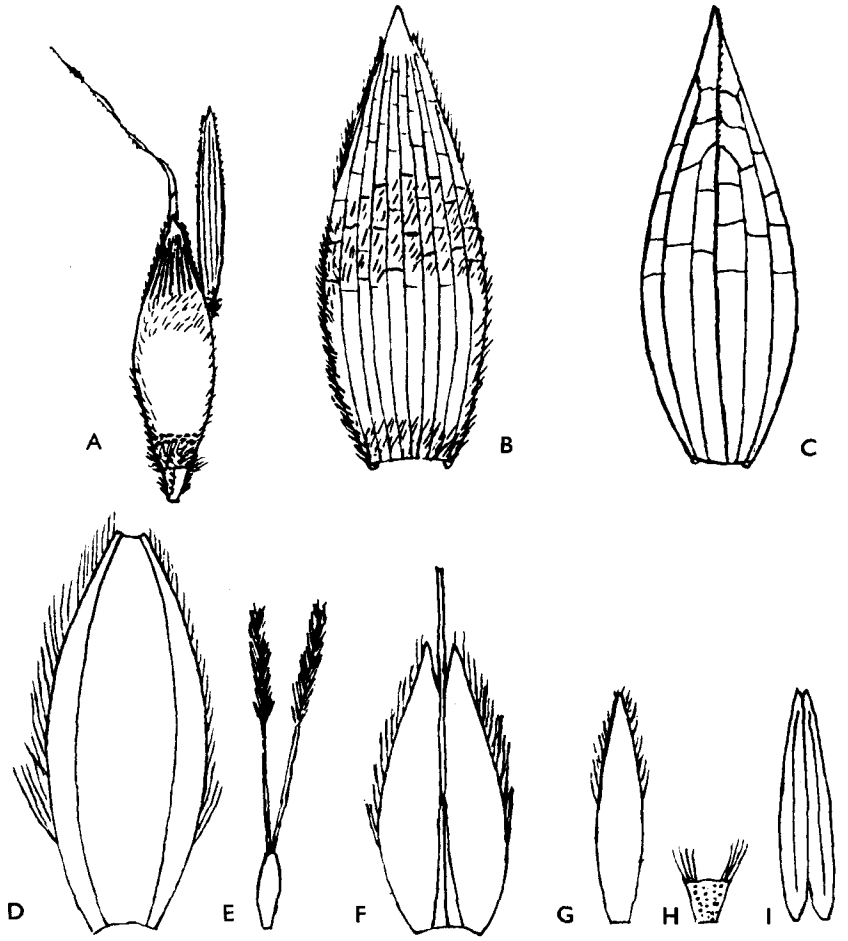
Northern Rhodesia. River Kafue, plains near Mazabuka, *Trapnell* 1092!

Southern Rhodesia. Deka River, Wankie, *Eyles* 7966!

10. **Sorghum arundinaceum** (Desv.) Stapf

Andropogon arundinaceus Willd., *Sp. Pl.* **4**, 906, 1805, is founded on a specimen collected by Isett in the Guinea region of West Africa. The name is a later homonym of *A. arundinaceus* Bergius, Descr. Pl. Cap. 356, 1767.

Rhaphis arundinacea Desv., *Opusc.* p. 69, 1831, is a different and legitimate generic combination used for *Andropogon arundinaceus* Willd.



Sorghum arundinaceum (Desv.) Stapf. A, sessile and pedicelled spikelets; B, lower glume; C, upper glume, exterior view; D, lower lemma; E, young ovary with styles and stigmas; F, upper lemma with lower part of awn; G, palea; H, one of the two lodicules; I, an anther. A, ×5; B–I, ×10. (From Herb. *Willdenow* 18,639.)

A. sorghum var. *effusus* Hack. in *DC., Monogr. Phan.* **6**, 503, 1889 (in part; excluding the specimens cited by Hackel from East and South Africa), is based on *A. arundinaceus* Willd.

Andropogon sorghum effusus Piper in *Proc. Biol. Soc. Wash.* **28**, 35, 1915, has the same basis.

Sorghum arundinaceum (Desv.) Stapf in Prain, *Fl. Trop. Afr.* **9**, 114, 1917, is based on *Andropogon arundinaceus* Willd. (non Berg., i.e. *Rhaphis arundinaceus* Desv.).

I have seen a fragment of the type specimen from Guinea, No. 18,639 in Herb. Willdenow. After examining the additional Sorghum material received at Kew from

Africa since Stapf's account of the African Sorghums was published, as well as the specimens in Kew herbarium cited by him and Piper, there is no reason to doubt that Stapf's concept of *Sorghum arundinaceum* agrees with that of *Andropogon arundinaceus* Willd. as far as the West African specimens I have seen are concerned, but I consider that most of the specimens from East and South Africa cited by Stapf are better placed under either *Sorghum verticilliflorum* or *S. macrochaeta*.

Description

A tall annual or tufted perennial 2–4 m. high. *Culms* stout, usually 1 cm. or more wide, often purplish below the nodes. *Leaves* many; blades linear, from a broad rounded base, narrowing upwards to the slender pointed apex, up to 75 cm. long, 2–6 cm. wide, mostly bright green, often flushed with purple, with a stout tapering mid rib. *Panicle* ovate to elliptic-oblong, loose, 20–60 cm. long, 10–25 cm. wide; branches often 5–8 from each of the lower nodes but reduced to 2–3 in depauperate specimens, obliquely ascending or spreading, slender and flexuous, the lower often 15–30 cm. long, usually undivided for 5–10 cm. or more from the villous base. *Racemes* fragile, 2- to 5-noded, up to 2·5 cm. long, internodes slender, 3–5 mm. long, densely ciliate with fulvous hairs up to 1·5 mm. long; pedicels similar but sometimes shorter. *Sessile spikelets* elliptic- to oblong-lanceolate, narrowly acuminate, 6–7·5 mm. long, 2–2·5 mm. wide, pale cream to straw-yellow or at length tawny to red or black, with 5–6 nerves showing between the keels near the tip of the lower glume, with a short awn or often awnless; callus beard copious. *Glumes* equal, coriaceous and often glossy to beyond the middle, somewhat papery above; lower with 12–16 primary nerves, numerous cross-nerves in the upper two-thirds, keeled in the upper third, with the keels finely margined, spinulously ciliolate and often terminating in minute teeth, more or less densely hairy with tawny to purplish hairs or sometimes becoming somewhat glabrous on the more exposed parts; upper with 7 primary nerves, many cross-nerves above the basal third, keeled above the middle, sharply in the upper third where it is usually scabrid, sparsely hairy on the back and sides. *Lemmas* finely long-ciliate; lower elliptic-lanceolate, 4·5–6 mm. long; upper elliptic-ovate to ovate, 3–4·5 mm. long, 2-lobed to 0·5–1 mm. deep and with an awn 5–10 mm. long, or often subentire and mucronate or with a short bristle. *Anthers* usually 3–3·5 mm. long. *Grains* obovate-elliptic to obovate, 2–3 mm. long, 1·5–2 mm. wide, yellowish brown to dark red or almost black; embryo-mark somewhat obscure. *Pedicelled spikelets* ♂ or sometimes neuter, 5–8 mm. long, somewhat greenish to purplish, at length deciduous, linear-lanceolate, acute; lower glume 9- to 11-nerved, upper 5- to 7-nerved.

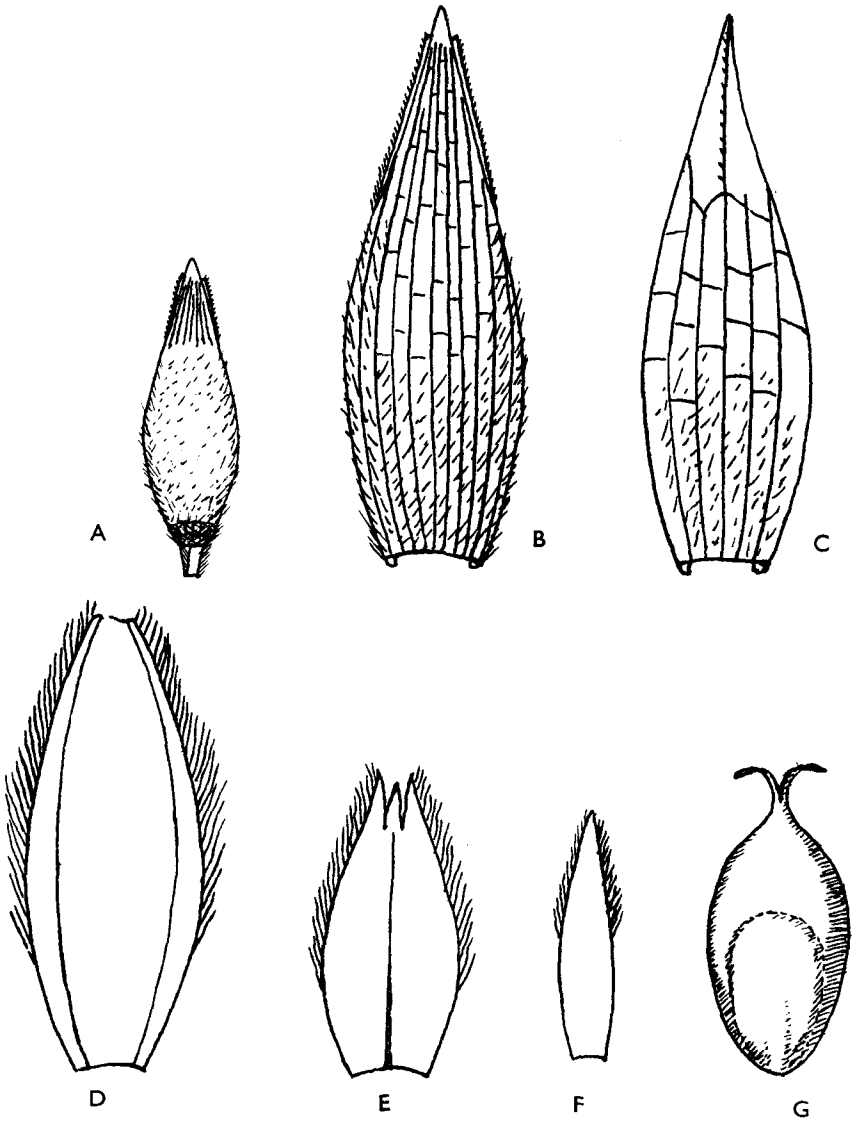
Diagnostic characters and affinities

The outstanding characteristics of *S. arundinaceum* are the large broad leaves; long loose panicle; and the elliptic- to oblong-lanceolate sessile spikelets 6–7·5 mm. long, 2–2·5 mm. wide, awnless or with only short awns 5–10 mm. long. It is closely related to *S. machrochaeta*, from which it is distinguished by the narrower sessile spikelets without awns or with only short awns. The short-awned or awnless sessile spikelets, wider leaves, together with the usually larger panicles, serve to separate it from *S. verticilliflorum*.

Distribution and utility

The natural distribution of this species appears to be mainly in low-lying lands along the Upper and Lower Guinea Coast of West Africa from Sierra Leone southwards to Damaraland. In the Belgian Congo, however, specimens have been recorded as far eastwards as Kindu in Costermansville district. Specimens from East and South Africa previously referred to *S. arundinaceum* probably belong to *S. verticilliflorum*. At an

early date during the time of the Slave Trade, probably towards the end of the eighteenth century, *S. arundinaceum* was introduced into some parts of the New World, notably Cuba and Brazil, possible along with the grain Sorghums brought over for food by the negroes of the Guinea Coast of Africa. Although Hackel (in *DC., Monogr. Phan.* **6**, 503,



Sorghum arundinaceum (Desv.) Stapf. A, sessile spikelet; B, lower glume; C, upper glume, exterior view; D, lower lemma; E, upper lemma; F, palea; G, grain surmounted by remains of styles. A, ×5; B–G, ×10. (From *Barter* 1379—an awnless form.)

1889) states that this species, which he names var. *effusus*, is cultivated in Brazil, Piper (in *Proc. Biol. Soc. Wash.* **28**, 37, 1915) thinks that this statement may have been based on information from a herbarium label, and mentions that Dorsett found it as a spontaneous weed, only rarely cultivated. Piper also mentions that at the time his account of the Sorghums was written (1915) it was being tested under cultivation in the

Gulf States of America. It has since spread to other parts of tropical and subtropical America. Although not extensively cultivated for fodder, its strong culms and abundant foliage make it well-suited for that purpose in hot humid regions where species from the drier mountainous regions of Africa are less likely to succeed. *S. arundinaceum* freely inter-crosses with the grain Sorghums of the subseries *Guineënsia* and *Drummondii*, and it seems probable that it has played an important role in the evolution of the West African grain Sorghums from the primitive types.

Specimens of this species are often found in cultivated lands, especially among crops of grain Sorghums, where it is said to become a troublesome weed. It seems to be most common on alluvial soils near streams, usually at lower altitudes up to about 500 m. above sea-level, generally in districts where the climate is hot and humid during the growing season.

Varieties

Hackel (in *DC., Monogr. Phan.* **6**, 503, 1889) described two subvarieties of var. *effusus*, namely subvar. *aristatus* with an awn 7–9 mm. long; and subvar. *submuticus* with the awn reduced to a more or less hidden mucro; but in other respects these subvarieties were similar. As the length of the awn is a variable character in some species, and it often varies by as much as 5–10 mm., in the absence of any other correlated character it seems best to regard these subvarieties as variable forms. In his citation of the specimens under *S. arundinaceum* Stapf gave no indication as to those having awned spikelets, but in all those given below that I have seen in the Kew Herbarium the specimens having sessile spikelets with a well-defined kneed or bent awn are denoted by an * immediately after the name or number of the collector.

Canary Islands. S. Domingos, among sugar cane (Jan. 1860) *Lowe*!

French Guinea. A specimen from Baffing Valley, *Pobéquin* 1807, which I have not seen, is cited by Stapf.

Sierra Leone. Musaia and Kennema, *Thomas* 2637 *! 7714! Musaia, *Glenville* 317 *! Segbwema, *Deighton* 3473!

Vern. names. Gawonge, Kete, Ndogbo-getei (Mende); Kende, Taiski (La.); Kitanbe, Tokboi (T.); Hula Marutuna, Muruntuna (Yalunka).

Liberia. Gbanga, in wet swale, *Linder* 508!

Ivory Coast. Area of Basulé South, between Zoumodi and Kzaakro, *Chevalier* 22,424!

Gold Coast. Northern Territories, Yapei, riverbank, *Lloyd Williams* 844! Aburi, *Johnson* 799! Winnebah Plains, *Dalziel* 8423! Banks of R. Dansu, at Nsawam, *Irvine* 1938! Without precise locality, *Irvine* 2673 *! Dodowa, *Deighton* 3389! Odumase, *Howes* 1203 *! Without precise locality, coll. *Bunting, Howes* 1211! Grown from seed collected by *Vinall*, ex *U.S. Dep. Agric. Sorghum Herb. S.P.I.* 03, 340!

Togo. A specimen is cited by Stapf from Misahöhe, *Baumann* 151.

Nigeria. Northern Nigeria: Nupe, *Barter* 1379! Southern Nigeria: Nun River, *Vogel* 50! Lagos, *Dalziel* 1322! Ibadan, *West* *! Ibadan Div., at Oke Ado, *Onochie* 7940 *! Abeokuta province, Egba Div. near Eriwa Road Station, *Onochie* 8143!

Vern. names: Oka-Iye (Yoruba).

Cameroons. Victoria—Buea Road, 122 m. *Maitland* 977!

The following specimens are cited by Stapf: Ossidinge, *Mansfield* 8; Mau Tschufi, *Ledermann* 4180; but I have not seen them.

Fernando Po. Without precise locality, *Mann* 114!

Guinea. Without precise locality, *Herb. Willdenow* 18,639 *!

St Thomas Island. *Moller* 150 *!

Spanish Guinea. Nkolentangan, Aleu, *Tessmann* 257 *!

A specimen from Fan, *Tessmann* 93, is cited by Stapf.

Gaboon. Adolinalongo, *Soyaux* 284!

BELGIAN CONGO. Stanley Pool, *Vanderyst* 3943 *! Barumba, *Bequaert* 1180! Costermansville, near River Congo, Kindu, *Shantz* 607 *! 623! 624! Kibwamba, *Shantz* 610! Kiti (1910), *Flamigni* 374! Kitobola, (1920), *Flamigni* 204! Butir and Buta, *Robyns* 1226!

The following specimens are cited by Stapf which I have not seen: Kisantu, *Gillet*; Lower Congo, *Smith*; without precise locality, *Demeuse*.

ANGOLA. I have not seen any specimens from this country, but Stapf cites the following: Cazengo, at Caculo, *Welwitsch* 2994; Ambriz, *Welwitsch* 2898; 2898/3; Icolo and Bengo, by the Bango River, *Welwitsch* 7197.

DAMARALAND. Stapf cites the following specimens which I have not seen: Tsoachaub, *Fleck* 403; Kuisib, *Fleck* 469; without precise locality, *Een*.

BRAZIL. Paraiba: ex Herb. Rep. Berolinense, *Sellow* 1250 *! Sergipe Sao Christovao, *Mun* 3745 *! Bahia: ex Herb. Hook. (1867), *Saltyman*! Minas Gerais: *Saint Hilaire* (Catal. 'A', 524) M. 339 *! on the ascent to Bovcorado (Bocauiva?) *Gardner* 144 *! Rio de Janeiro: comm. *Glaziou* (*Guinta* 31) 3150 *! 1633 *! 6961 *! *MacGillivray* 212 *! ex Herb. Hort. Petropolitani, *Reidel* 1231 *! Without precise locality *Burchell*, 1632 *!

A specimen from Pernambuco, ex Herb. Hook., 1867 (common in waste and cultivated places, No. 1837), *Gardner* 1177! may be a weak immature flowering state of this species.

Besides the synonyms already given above, Hackel included under *Andropogon sorghum* var. *effusus* the names *Holcus decolorans* Willd., *Sp. Pl.* **4**, 931, 1805; *Andropogon decolorans* Kunth in Humbolt et Bonplond, *Nov. Gen.* **1**, 190, 1815; and *Sorghum decolorans* Roem. et Schult., *Syst. Veg.* 2, 838, 1817 (the two latter being new names for *Holcus decolorans* on transferring the species to different genera). He also included *Trachypogon avenaceus* Nees in Martius, *Fl. Bras.* **2**, 354, 1829, which is a different generic reference for *Andropogon avenaceus* Kunth (loc. cit. p. 189), and may have been inadvertently used instead of *A. arundinaceus*; as well as *Sorghum halepense* Nees, *Fl. austr.* p. 88, 1841 [non *S. halepense* (Linn.) Pers., *Syn.*, **1**, 101, 1805].

Holcus decolorans Willd. and *Andropogon decolorans* Kunth were based on specimens from Cuba and Venezuela. As all the specimens from those countries at that time in the United States National herbarium were *Andropogon halepense* (Linn.) Brot., a species with perennial rhizomes, Piper (in *Proc. Biol. Soc. Wash.* **28**, 35, 36, 1915) considers the above references doubtful, except those concerning the inadvertent use of the name *Trachypogon avenaceus* Nees, which had particular reference to specimens from Brazil, where var. *effusus* (*Andropogon arundinaceus*) is abundant. Regarding *Sorghum halepense* Nees (non Pers.), no special reference is made by Piper, but it was later included by Stapf (in Prain, *Fl. Trop. Afr.* **9**, 117, 1917) in synonomy under *S. verticilliflorum*, to which these South African specimens belong.

I have been able to examine only a few of the specimens cited by Hackel under var. *effusus*, but it is evident that he included elements of more than one species, as since recognized by Piper, Stapf, and myself. The first specimen cited by Hackel, *Schweinfurth* 1521, from the Anglo-Egyptian Sudan, is the type of *S. macrochaeta*, and that of *Böhm*, from Lake Tanganyika, belongs to the same species; those of *Moller* and *Barter*, from West Africa, are both *S. arundinaceum*; that of *Drège* from South Africa is *S. verticilliflorum*. The other specimens from Natal, Mauritius, and Madagascar, cited by Hackel, have not been seen by me but probably belong either to *S. verticilliflorum* or a related East African species.

11. **Sorghum verticilliflorum** (Steud.) Stapf

Andropogon verticilliflorus Steud., *Syn. Pl. Glum.* **1**, 393, 1854, was founded on a specimen from the island of Bourbon (Réunion).

A. sorghum (Linn.) Brot. subsp. *verticilliflorus* Piper in *Proc. Biol. Soc. Wash.* **28**, 37, 1915, is based on Steudel's species.

Holcus sorghum Linn. subsp. *verticilliflorum* (Steud.) Hitchc. in *Proc. Biol. Soc. Wash.* **29**, 128, 1916, has the same basis.

Sorghum verticilliflorum (Steud.) Stapf in Prain, *Fl. Trop. Afr.* **9**, 116, 1917, is also based on *Andropogon verticilliflorus* Steud.

I have not been able to see, or to locate, the type specimen, but after careful examination of all the Sorghum material from East and South Africa available at Kew, including specimens from Bourbon and the neighbouring islands collected soon after Steudel's description was published, I find that some of the material from the East African coastal area and the islands in the Indian Ocean differ from *Sorghum verticilliflorum* (as described by Stapf and since generally accepted), and is best treated as a related but distinct species which I have named *S. brevicarinatum* (see no. 14).

Description

An annual or loosely tufted perennial 1–3·5 m. high. *Culms* slender to somewhat stout, 5–10 mm. wide, sometimes purplish below the nodes. *Leaves* few to many; blades linear, with a rather broad rounded base, tapering gradually upwards to the pointed apex, about 30–60 cm. long, 1–3 cm. wide, green, sometimes glaucous, often flushed with purple, with the paler stoutish mid rib gradually narrowing upwards. *Panicle* 15–50 cm. long, 5–15 cm. wide, pyramidal to ovate-elliptic or elliptic-oblong, somewhat contracted or more often loose and spreading; branches slender, ascending or at length flexuous and bending outwards, shortly hairy to somewhat villous at the base, the lower ones often 3–5 in a whorl and 5–20 cm. long, sparingly branched and usually bare of spikelets for 2–5 cm. from the base. *Racemes* fragile, 2- to 5-noded, 1·5–2·5 cm. long; internodes and pedicels slender, 2·5–4 mm. long, densely ciliate with greyish white, tawny or purplish hairs. *Sessile spikelets* elliptic-lanceolate, acuminate, mostly 6–7 mm. long (but sometimes reduced to 5·5 mm.), 2–2·5 mm. wide, with 5–7 nerves evident between the keels of the lower glume, pale yellow to deep cream, or at length becoming reddish brown to purplish or black, usually more or less strigosely hairy when young but often glabrous and shining on the exposed portions when mature; awned; callus beard scanty to copious. *Glumes* coriaceous for the most part but somewhat thinner in the upper third where the nerves become visible; lower rather flat above the middle, with 11–13 primary nerves, some cross-nerves above the basal third, 2-keeled from just above the middle, with the spinulously ciliolate keels narrowly margined and terminating in obscure or very minute teeth below the hyaline tip; upper with 7 (rarely 8) primary nerves, cross-nerves present in the upper half, keeled above the middle, more sharply in the upper fourth where it is more or less rough. *Lemmas* densely long-ciliate; lower elliptic-lanceolate, 4·5–6 mm. long; upper ovate to ovate-elliptic, 3–5 mm. long, 2-lobed to 1·5 mm. deep, awn 10–16 (rarely 18) mm. long. *Anthers* 2·5–4 mm. long. *Grains* obovate-elliptic to obovate, 2·5–3·5 mm. long, 1·5–2 mm. wide, pale to dark brown or dark red, embryo-mark distinct. *Pedicelled spikelets* ♂ or sometimes reduced, deciduous, pale greenish yellow or often reddish to purplish, 5–7 mm. long; lower glume 8- to 10-nerved, upper 5- to 6-nerved; anthers 2·5 mm. long.

Diagnostic characters and affinities

The slender to somewhat stout culms; long narrow leaves mostly 0·5–2·5 cm. wide; and narrow elliptic-lanceolate, rather long-awned sessile spikelets, usually 6–7 but sometimes 5·5 mm. long, are the distinguishing features of *S. verticilliflorum*. The narrow leaves serve to separate it from both *S. arundinaceum* and *S. macrochaeta*. It also has longer awns than the former and narrower somewhat shorter-awned spikelets than the latter. In normal well-developed specimens of *S. arundinaceum* and *S. macrochaeta* the panicles are usually larger than those of *S. verticilliflorum*, but this difference is not always apparent

as the size of the panicles is apt to vary somewhat according to the conditions under which the plants have been grown. *S. brevicarinatum* differs in the ovate-elliptic sessile spikelets, 4·5–5·5 mm. long, with shorter broader-margined keels, and leaves often 3–5 cm. wide. The shape of the lanceolate sessile spikelets distinguishes *S. lanceolatum* from *S. verticilliflorum*.

Distribution and utility

In North Africa the natural distribution of this species commences near the northern boundaries of Uganda and Kenya, but it also occurs in southern Abyssinia and Italian Somaliland. Southwards it extends through Tanganyika Territory, Nyasaland and Rhodesia to South Africa as far as the Orange River and Natal. Its western limit is generally near the borders of the western Rift Valley (including that part of the Belgian Congo which adjoins it) until it reaches Northern Rhodesia, but a single specimen has been recorded from Benguella, Angola, on the West African coast. On the east it does not appear to be common in the coastal lands of Kenya and Tanganyika Territory, but it has been recorded from near the mouth of the Zambesi River, as well as from the Mascarene Islands, including Réunion (Bourbon). It seems probable that it originated somewhere in the vicinity of the Great Lakes and Upper Nile region of Central Africa, where it is most abundant and widespread, but was carried southwards along the lakes and rivers of the western and eastern Rift Valleys by the Bantu races as they travelled southwards to the Transvaal, Orange Free State, and Natal, whence it was introduced into some of the Islands of the Indian Ocean. During more recent times it has been introduced into various countries, including India, Australia, Polynesia, and the West Indies.

Many of the African native races look upon it as a wild state of their cultivated grain Sorghums, and in times of famine the natives sometimes eat the grains from the wild plants. It intercrosses freely with the Sorghums cultivated in areas where it grows wild, especially varieties of *S. roxburghii*, *S. caudatum*, and *S. caffrorum*, and specimens that have evidently resulted from such cross-fertilization are often encountered. It has been cultivated to some extent as fodder, in those stock-raising countries into which it has been introduced, including some parts of South Africa and Australia. For this purpose it has about the same utility as Sudan Grass (*S. sudanense*), but it is doubtful if it will entirely replace the latter species, as it suffers from the disadvantage of the fragile racemes shattering when mature, which makes the collection of seed more costly and difficult.

The toxicity of *S. verticilliflorum* is about equal to that of *S. sudanense*, and cases of Sorghum poisoning due to animals feeding on it have been reported from South Africa and Australia. In Steyn's account of 'The Toxicology of Plants in South Africa' (*Onderstepoort J. Vet. Sci.* **3**, 421–2, 1934), under the heading *S. verticilliflorum*, on p. 421, the South African Sorghum concerned is probably this species, but there is also much reference to Johnson Grass (*S. halepense* Pers.), which has wide-spreading rhizomes and should be easily distinguishable from *S. verticilliflorum*. In Australia, in *The Poison Plants of New South Wales*, p. 28, 1942, Hurst records under *S. verticilliflorum* that White states the HCN content of this species to be exceedingly high at practically all stages of growth and that in this respect it is one of the worst Sorghums so far tested. It is said to be dangerous to stock almost throughout the growing period and strongly cyanogenetic. The use of this species as fodder for domestic animals would therefore appear to need careful investigation and control, although under normal conditions most Sorghums generally become harmless at maturity.

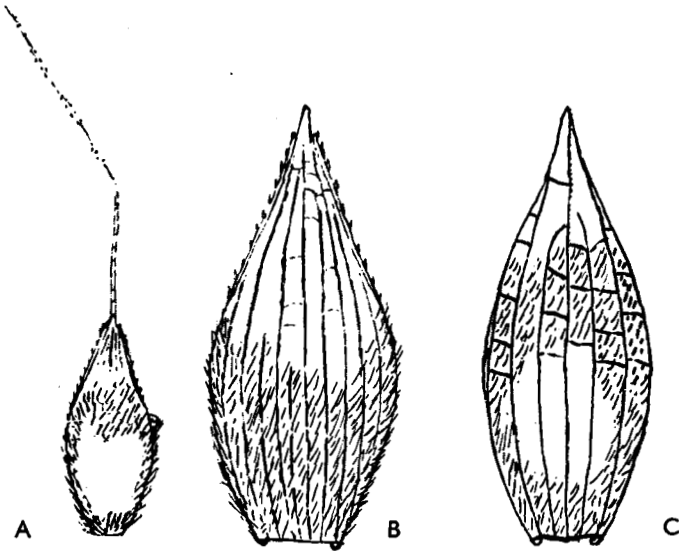
S. verticilliflorum is generally found growing in or near to cultivated lands, especially in abandoned cultivations that are overgrown and reverting to a mixture of grassland, bushland and woodland. Though often found near lakes and streams, it is probably still more frequent on hilly lands. The variety *infrequens* has a limited distribution and is

found mainly in areas near the equatorial region of Africa, but var. *ornatum*, which appears to be the most common, and var. *verticilliflorum* extend from the northern to the southern limits of distribution in Africa. The former is generally most frequent on the reddish soils of the hill lands and the latter is more often found on the dark soils of the plains and valleys, but the factors governing their local appearance are by no means clear. Var. *verticilliflorum* is the one generally found in India and Australia.

(i) Var. verticilliflorum

Var. **verticilliflorum** is based on *Andropogon verticilliflorus* Steud. I have not yet been able to locate the type specimen of the species, but the variety, as here defined, is restricted to those plants with rather broad and somewhat short sessile spikelets.

Sessile spikelets broadly elliptic-lanceolate, 6–6·5 mm. long, 2–2·5 mm. wide, mostly dull cream to tawny, but sometimes reddish to black; base of the lower glume rather wide and somewhat pear-shaped.



Sorghum verticilliflorum (Steud.) Stapf var. *verticilliflorum*. A, sessile spikelet and apex of pedicel; B, lower glume; C, upper glume, exterior view. A, ×5; B and C, ×10. (From *Balfour*, coll. on Bourbon Island.)

Belgian Congo. Mahagi Port, near Lake Albert, 625 m., *Johnson* 1153! Bunia, near Lake Albert, 1370 m., *Johnson* 1109! Semliki Valley, 670 m., *Johnson* 1223! Bukama, on river bank, *Shantz* 561! Francis Camp, west of Lake Uionga, *Shantz* 589! Msala, near Nyanza, Lake Tanganyika, *Shantz* 679!

Uganda. Teso district, Serere, 1097 m., *Chandler* 743! Bulemezi, *Johnson* 102! Plains of Lake Albert, near Butiaba, 610 m., *Johnson* 942! Toro district, at Kikorongo, 1087 m., *Maitland* 1400!

Vern. name: Muhembahemba (Luganda).

A specimen collected near Lake Kioga, *Michelmore* 1212! is somewhat intermediate between this variety and *S. niloticum*. It may have resulted from intercrossing between one of these two species and a cultivated grain Sorghum.

Kenya Colony. Kavirondo country, 6 days' march from Mumias (1898), *White*! Nyanza province, Maseno, 1524 m., *Benstead* 3101! South Kavirondo, Kitutu, 1676 m., *Spranger* S62! Machakos district, Kibwezi, 884 m., *Dummer* 4544! Lorgasailie Plains, 1158 m., *Andrews* B5190!

Vern. name: Hesamu.

TANGANYIKA TERRITORY. Moshi district, 915 m., *Haarer* 364! Mpwapwa district, *Staples* 251!

NORTHERN RHODESIA. Chilonga district, at Quien Sabe and Kusaka Farm, *Sandwith* 20! 62!

SOUTHERN RHODESIA. Makwiro district, *Mainwaring* 7640! Makwiro, 1310 m., *Eyles* 2100! Salisbury, 1430 m., *Eyles* 2121! ex *U.S. Dep. Agric. Sorghum Herb. S.P.I.* 56,801!

NYASALAND. Between Kondowe and Karonga (1896), *White*! Port Herald Experiment Station, *Lawrence* 46!

PORTUGUESE EAST AFRICA. Msalu River, Nyasa district, *Allen*! Boruma, *Meynharth* 1044!

MASCARENE ISLANDS. Réunion (Bourbon) Island, *Balfour*!

MAURITIUS. Without precise locality (Oct. 1872), *Pike*! *Vaughan* A 8!

A specimen grown from seed collected by *Reed* at Reduit, Mauritius, and cultivated at Chula Vista, California, ex *U.S. Agric. Dep. Sorghum Herb. S.P.I.* 40,897! has wider leaves and persistent spikelets and may be the result of intercrossing between this species and a cultivated grain Sorghum.

SEYCHELLE ISLANDS. Ex *U.S. Agric. Dep. Sorghum Herb. S.P.I.* 40,773!

INDIA. Without precise locality, *Wallich* 8778 D/3! 8778 F/1! *Herb. Wight* 1672! Mirittipadu (Nov. 1794) *Herb. Rottlerianum*!

Vern. name: Tabucki Grass from the Cape (from South Africa).

Specimens from Madras, used in hybridization experiments with *Saccharum* spp., *Janaki Ammal* 1235! may be hybrid forms of this variety.

AUSTRALIA. Queensland: Brisbane, Upper Brookefield near Brisbane, and Brisbane River, *White* (June, 1926)! 6! 11! Brisbane, Kangaroo Point, *Winchester*! Between Pinkinba and Meeandah, near Brisbane, *Blake* 5029! Terongpilly, near Brisbane, *Longman*! Brisbane and vicinity, including Sherwood, Milton, Toowong, and banks of the Brisbane River, *Hubbard* 2378! 2872! 4730! 2167! 4809! Between Lanesfield and Rosewood, 36 miles south-west of Brisbane, *Hubbard* 2142! Emerald, *Hubbard* 7922! Between Teirotville and Anthony, Hubbard 5370! Chudleigh Park Station, 110 miles north of Hughenden, *Hubbard & Winders* 7658! Petrie, *Blake* 228! Pialba, *Pointon*! Booyal via Childers, *Colman* 19! Toowong Creek near One Tree Hill, *Blake & Everist* 222! Port Jackson to Blue Mountains, *Cunningham*! Stratford near Cairns, *Dalziel*! State Farm, Hermitage, Warick, *Liverseed* 8! Waterford, *Mead*!

Cunningham's specimen was cited by Bentham (in *Fl. Aust.* 7, 540, 1878) under *S. plumosum* Beauv.

COOK ISLANDS. Karatonga, *Cheeseman* 723!

SAMOA. Upsolu (May 1895), *Flora Samoensis, Reineke*!

SOLOMON ISLANDS. *White, B.S.I.P.* 132!

SOCIETY ISLANDS. Tahiti, ex *U.S. Agric. Dep. Sorghum Herb. S.P.I.* 42,278!

ST VINCENT. Without precise locality, *Maling* 5! *Guilding* 2822!

ST KITTS. Pond Estate, near Basseterre, *Box* 130!

CUBA. Bayamesa, 500 m., *Fl. Indiae Occidens, Eggers* 4678!

DOMINICAN REPUBLIC. Barahona province, near Rincon, *Flora Domingensis leg. Pedre Miquel Fuertes* (Oct. 1911)!

(ii) Var. **ornatum** Snowden

Var. **ornatum** Snowden, var.nov.; spiculae sessiles anguste elliptico-lanceolatae, 6–7 mm. longae, 2–2·5 mm. latae, saepe rubrae vel purpureae, demum cacao-brunneae, vel nigrae; gluma inferior basin versus angusta, amygdaliforma.

Sessile spikelets narrow elliptic-lanceolate, 6–7 mm. long, 2–2·5 mm. wide, often

reddish to purplish coloured, or at length dark chocolate brown to black; base of the lower glume slender, curving gradually outwards and more or less almond-shaped.

This variety is based on two specimens in the Kew Herbarium collected by *Drège* near the Orange River at Verleptpram.

ANGLO-EGYPTIAN SUDAN. Nimule, near the boundary with Uganda, *Shantz* 895! 899!

UGANDA. Karamoja district, Napak, 1220 m., *Thomas* 3657! Mbale district, near Mbale, *Snowden* 1099! Entebbe district, at Entebbe (1902), *Mahon*! Victoria Nyanza Region, 1175 m., *Maitland* 89! 92! Mengo district, at Kipayo, 1220 m., *Dummer* 474! 1278! Masaka district, near Masaka, 1280 m., *Snowden* 1388! Ankole district, near Mbarara, 1402 m., *Snowden* 1374!

Vern. name: Muhembahemba (Luganda).

The specimen *Dummer* 1278 is malformed owing to damage by 'Smut Disease'.

KENYA COLONY. Nyanza province: Maseno, 1524 m., *Sampson* 85! Fort Ternan and Koro, ex *U.S. Dep. Agric. Sorghum Herb. S.P.I.* 51,577! 51,578! Fort Hall district, ex *U.S. Dep. Agric. Sorghum Herb. S.P.I.* 51,439! *Pole Evans* 1168! 16 miles north of Thika, *Pole Evans* 1172! Blue Post, near Nairobi, *Shantz* 834! Embu to Nairobi, *Shantz* 973! Nairobi, *Dowson* 315! Kisii, 1646 m., *Napier* 5368!

TANGANYIKA TERRITORY. Moshi district, Marangu, *Davis* 1129! Pare district, Kiruru, 762 m., *Haarer* 1280! Kondoa district, near Sambala, 1463 m., *Burtt* 2605! 18 miles north of Mawhamuta, *Pole Evans* 1009! Central Railway at Lyamungu, 1310 m., *Wallace* 1161! Kasunika, near Rungwa, *Michelmore* A.C. 1603! without precise locality, *Rounce* 330!

Vern. name: Sambankona (Chi-Fipa).

NORTHERN RHODESIA. Lunsefwa River, *Burtt Davy* 904/29!

SOUTHERN RHODESIA. Salisbury: *Townsend* (Feb. 1909)! Makwiro district, ex *Dep. Agric. Herb.* 42 (27/21)!

NYASALAND. Near Chiromo, 38 m., *Wiehe* 207!

PORTUGUESE EAST AFRICA. Below Mazzawo, between Tette and the sea, *Kirk* (March–April, 1860)!

BECHUANALAND. Banks of the Zebanini River, *Pole Evans* 3319(15)!

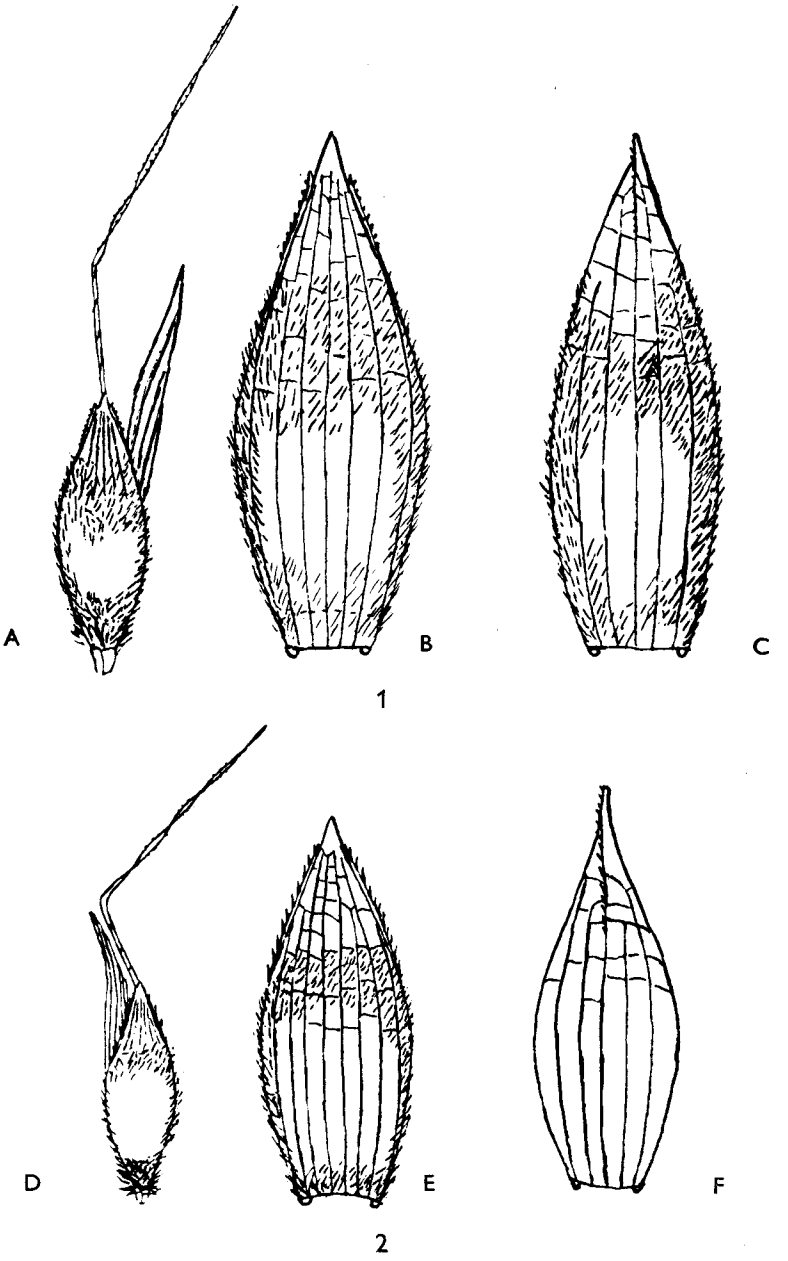
SOUTH AFRICA. Cape province: Hereroland, at Tsavehaub and Kuisib, *Fleck* 403! 469! Little Namaqualand, at Verleptpram near the Orange River, below 150 m. (Sept. 1840), *Drège*! Pondoland, Tamvoona River, *Burtt Davy* 15,373! Herbert district, St Clair near Douglas, 1050 m., *MacOwan* 185! 1995! Knysna Division, on the hills near Melville, *Burchell* 5465B! Upington, on the banks of the Orange River, *Moss* 10,980! Kimberley, from seed obtained near the Vaal River, *Wilman* C7! Natal province: Durban, *Gerrard* 690! Verulam, *Rehmann* 9070! Umhlanga, *Wood* 1332! near the Umlazi River, *Krauss* 184! Banks of the Tugela River, *Buchanan* 296! Transvaal province: Pretoria, cultivated but indigenous, *Melle* H20, 940! Seed from Pretoria and Nelspruit, ex *U.S. Dep. Agric. Sorghum Herb. S.P.I.* 40,832! 49,304!

Another specimen from *U.S. Sorghum Herb., S.P.I.* 38,866! which has wider leaves and tough racemes, is probably the result of intercrossing with a cultivated race.

(iii) Var. **infrequens** Snowden

Var. **infrequens** Snowden, var.nov.; spiculae sessiles anguste elliptico-lanceolatae, 5·5–6 mm. longae, 2–2·2 mm. latae, plerumque rubrae, rubido-brunneae, vel nigrae, pilis rubiginosis vel rubidopurpureis saepe dense strigosae, raro pilis subalbidis et glabrescentes; gluma inferior basin versus angusta, amygdaliforma.

Sessile spikelets narrow elliptic-lanceolate, 5·5–6 mm. long, 2–2·2 mm. wide, mostly mahogany-red to reddish brown or black, usually densely strigose with ferruginous to reddish purple hairs, but sometimes almost glabrous with the hairs whitish; base of the lower glume slender, curving gradually outwards and more or less almond-shaped.



Sorghum verticilliflorum (Steud.) Stapf. (1) Var. *ornatum* Snowden. A, sessile and pedicelled spikelets; B, lower glume; C, upper glume, exterior view. (From *Drège*, coll. by the Orange River.) (2) Var. *infrequens* Snowden. D, sessile and pedicelled spikelets; E, lower glume; F, upper glume, exterior view. (From *Thomas* 3884.) A and D, × 5; B, C, E and F, × 10.

The type of this variety is a specimen collected at Athobi, in the Lango district of Uganda, *Thomas* 3884, in Kew Herbarium.

ABYSSINIA. Modjo, ex *U.S. Dep. Agric. Sorghum Herb. S.P.I.* 58,742!

UGANDA. Lango district, at Athobi, 1070 m., *Thomas* 3884!

KENYA COLONY. Fort Hall, near Nairobi, *Shantz* 835! Blue Post to Nairobi, *Shantz* 836! Embu to Nairobi, *Shantz* 976! 977! 979! Meru and Thika, ex *U.S. Dep. Agric. Sorghum Herb. F.C.I.* 8678! 8698!

TANGANYIKA TERRITORY. Kigoma, near Lake Tanganyika, *Shantz* 764!

ANGOLA. Near Port Amboin, *Gossweiler* 9770!

BRITISH GUIANA. New Amsterdam, *Hitchcock* 16,818!

Nees von Esenbeck (in *Fl. Afr. Aust.* p. 88, 1841) placed the South African Sorghums under *Sorghum halepense*, which is a perennial with well-developed rhizomes having a natural distribution more or less confined to the Mediterranean Region and the adjacent parts of western Asia. Up to that time, however, most of the wild Sorghums had been regarded as varieties of *S. halepense*, so that it is easy to understand why they were referred to the latter species. Unfortunately it has since led to some confusion on account of *S. halepense* having been placed by many authors in the synonomy of other species and varieties of *Sorghum* that do not possess distinct rhizomes and have since been separated into a different subsection, *Arundinacea*.

Hackel (in *DC., Monogr. Phan.* **6**, 503, 1889) included these South African Sorghums under *Andropogon sorghum* var. *effusus*, which as here understood is restricted to *Sorghum arundinaceum* (Willd.) Stapf, (in Prain, *Fl. Trop. Afr.* **9**, 114, 1917), based on *Andropogon arundinaceus* Willd. Before this revision of the African Sorghums was completed Stapf, when dealing with the Sorghums in Hook., *Fl. Brit. India*, **7**, 183, 1896, and in Dyer, *Fl. Cap.* **7**, 346, 1898, had not fully defined the limits of the genus *Andropogon* and therefore had no alternative but to follow Hackel in placing the wild species of Indian and South African Arundinaceous Sorghums under *A. halepensis* (Linn.) Brot.

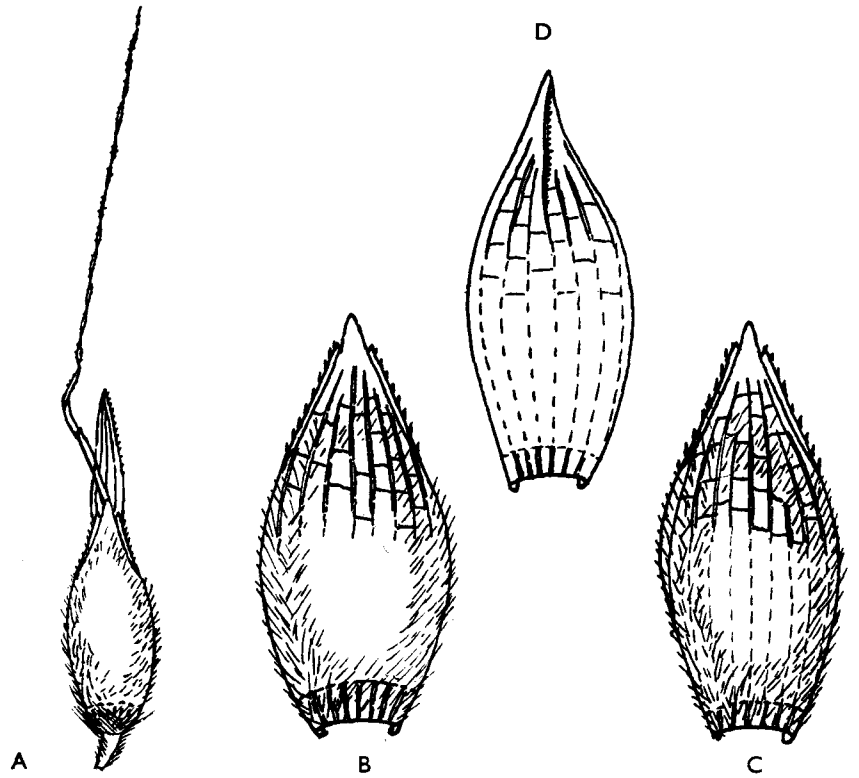
12. **Sorghum somaliense** Snowden

Sorghum somaliense Snowden, sp.nov.; affine *S. verticillifloro* (Steud.) Stapf sed culmis gracilioribus, humilioribus, foliis parvioribus, laminis foliorum apicibus longe attenuatis filiformibus, panicula parviore angustiore, spiculis sessilibus elliptico-lanceolatis vel ellipticis acutis, 5·5–6 mm. longis, aristis longioribus gracilioribus differt.

Gramen annuum, 0·5–1 mm. altum. *Culmi* graciliusculi, basin versus 3–4 mm. lati. *Folia* pauca, laminae anguste lineari-lanceolatae, 10–30 cm. longae, 0·5–2 cm. latae, basi latiusculae vel leviter contractae, in apicem filiformem longe attenuatae, costa media validiuscula subalbida. *Panicula* anguste oblonga, 10–25 cm. longa, circiter 1–2 cm. lata, laxa; axis primarius sursum angulatus, striatus, scabridus; rami solitari vel 2–3-nati, gracillimi, erecti vel suberecti, superne tenuiter spinulose ciliati, basin versus leviter hirsuti, inferiores 3–8 cm. longi, saepe 1–2 cm. nudati. *Racemi* fragillimi, 2–5-nodis, 1–2·5 cm. longi; rhacheos internodia gracillima, 2–3 mm. longa, pilis subalbidis vel pallido-purpureis 0·5–1 mm. longis ciliata; pedicelli internodiis similes. *Spiculae sessiles* elliptico-lanceolatae vel ellipticae, acutae, 5·5–6 mm. longae, 2–2·5 mm. latae, aristatae, primo stramineo-flavae vel eburneo-flavae plus minusve hirsutae, vel demum saepe pallido- vel atro-purpurascentes, dorsis glumarum fere glabrae; callus dense barbatus. *Glumae*, regione apicali tenui et chartacea excepta, coriaceae; inferior 12-nervis, triente superiore bicarinata, carinis spinulose ciliolatis, dentibus minutis nonnunquam terminatis; superior 7-nervis, apicem versus carinata, carina scabrida. *Lemmata* tenuiter longiciliata; inferius elliptico-oblongum, 4·5–5 mm. longum, exiliter 2–3-nerve, apice breviter bidentatum incisione circiter 0·3 mm. diametro paene orbiculata; superius elliptico-ovatum, 2·5–4 mm. longum, tenuiter 3-nerve, breviter bilobum, arista gracilis, 15–18 mm. longa. *Antherae* 2 mm. longae. *Caryopsides* ellipticae, circiter 3·5 mm. longae,

2 mm. latae, nigro-brunneae. *Spiculae pedicellatae* lineari-lanceolatae, acuminatae, 5–6 mm. longae, ♂ vel interdum redactae, stramineo-flavae vel virido-flavae, deciduae; gluma inferior 8–9-, superior 5-, nervis; antherae 1·5–2 mm. longae.

An annual 0·5–1 m. high. *Culms* rather slender, about 3–4 mm. wide near the base. *Leaves* few; blades narrowly linear-lanceolate, 10–30 cm. long, 0·5–2 cm. wide, with a rather broad or slightly contracted base, long-tapering upwards into a filiform tip, with the mid rib rather stout and whitish. *Panicle* narrow-oblong, 10–25 cm. long, about 1–2 cm. wide, loose; rhachis angular, striate and rough in the upper part; branches solitary or 2- to 3-nate, very slender, erect or suberect, finely spinulously ciliolate upwards, slightly hairy near the base, the lower 3–8 cm. long, often bare for 1–2 cm. from



Sorghum somaliense Snowden. A, sessile and pedicelled spikelets; B, lower glume of fruiting spikelet; C, lower glume of younger spikelet; D, upper glume; all three exterior view. A, × 5; B–D, × 10. (From *McKinnon* S/274.)

the base. *Racemes* very fragile, 2- to 5-noded, 1–2·5 cm. long, internodes and pedicels slender, 2–3 mm. long, ciliate with whitish or pale-purplish hairs 0·5–1 mm. long. *Sessile spikelets* elliptic-lanceolate to elliptic, acute, 5·5–6 mm. long, 2–2·5 mm. wide, pale straw to cream colour with greenish nerves evident near the tip of the lower glume when young, at length light to dark purple, coarsely hairy with whitish hairs or glabrescent on the backs of the glumes, awned; callus densely bearded. *Glumes* coriaceous for the most part but somewhat thinner near the tip; lower 12-nerved, with a few cross-nerves above the middle, 2-keeled in the upper third with the spinulously ciliolate keels sometimes ending in minute teeth; upper 7-nerved, with a few fine cross-nerves in the upper half, keeled towards the tip, scabrid on the keel. *Lemmas* finely long-ciliate; lower elliptic-oblong, 4·5–5 mm. long, finely 2- to 3-nerved, the 2-toothed apex with an almost circular

notch about 0·3 mm. in diameter; upper ovate-elliptic, 2·5–4 mm. long, faintly 3-nerved, 2-lobed to 0·5–0·7 mm. deep, with a slender awn 15–18 mm. long. *Anthers* 2 mm. long. *Grains* elliptic, about 3·5 mm. long and 2 mm. wide, dark brown. *Pedicelled spikelets* linear-lanceolate, 5–6 mm. long, ♂ or sometimes reduced, straw-yellow or somewhat greenish, deciduous; lower glume 8- to 9-nerved, upper 5-nerved; anthers 1·5–2 mm. long.

The type of this species is a specimen in Kew Herbarium, *McKinnon* S/274, collected in Somaliland.

Diagnostic characters and affinities

S. somaliense is related to *S. verticilliflorum* Stapf but differs in the more slender shorter culms; smaller leaves with long-tapering filiform tips; the smaller, narrower and sparsely branched panicle; and in the sessile spikelets elliptic-lanceolate to elliptic, acute, 5·5–6 mm. long, 2–2·5 mm. wide, with longer more slender awns. The small narrow leaves with filiform tips, the sparse panicle with the branches keeping close to the main axis, together with the almost elliptic sessile spikelets with comparatively long slender awns, form the most characteristic features of this species.

Distribution and utility

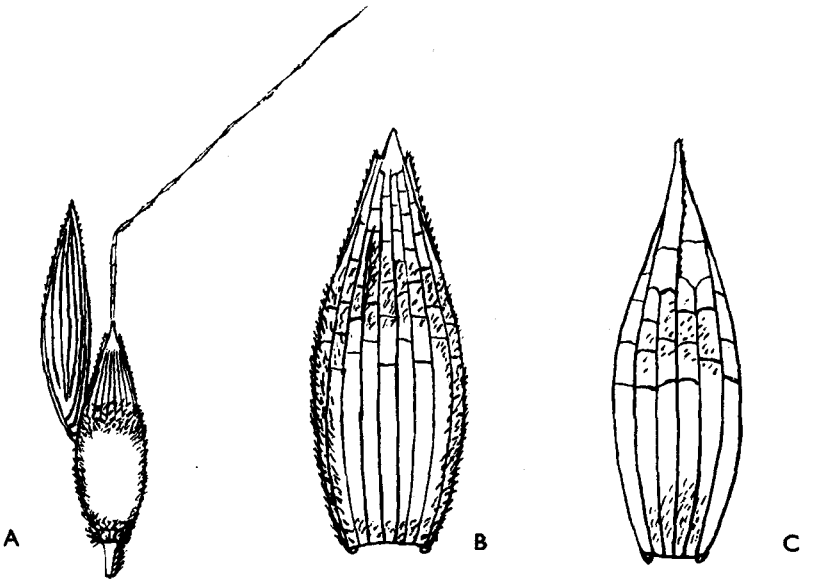
The original gathering from Somaliland is the only material of this species that has been received at Kew. No information is at present available as to its utility. The foliage is not luxuriant enough to suggest a very good fodder plant. It appears to have been grown in a very dry region, however, and it might prove useful in districts with a low rainfall and a hot climate.

13. **Sorghum pugionifolium** Snowden

Sorghum pugionifolium Snowden, sp.nov.; a *S. somaliensi* Snowden culmis graciliori-bus, foliis parvioribus saepe pugioniformis, spiculis sessilibus oblongo-lanceolatis acuminatis, glumis subcoriaceis differt.

Gramen annuum, 50–60 cm. altum. *Culmi* graciles, 1–2 mm. lati, plerumque simplices. *Folia* pauca; vaginae superiores plerumque ter, quater, vel quinquies longiores quam laminae; ligulae superiores subdeltoides, 2–3 mm. longae; laminae saepe pugioniformae, angustae, longi-acuminatae, 4–10 cm. longae, 3–9 mm. latae, glabrae, nervo medio gracile pallidiore excepto, virides. *Panicula* anguste oblonga, 4–12 cm. longa, 1–2 cm. lata, e vagina summa 8–12 cm. exserta; axis primarius gracilis, teres, tenuiter striatus; rami graciles, 1–3-nati, 1–7 cm. longi, superne tenuiter spinulose ciliolati, basin versus hir-suti 1–2 cm. nudati, cetera glabri. *Racemi* fragiles, 2–4-nodis, 1–1·5 cm. longi; rhacheos internodia gracillima, 2·5–4 mm. longa, saepe purpurascentia, pilis subalbidis 0·5–1 mm. longis ciliata; pedicelli internodiis similes. *Spiculae sessiles* oblongo-lanceolatae, acumi-natae, 5·5–6·5 mm. longae, 1·5–2 mm. latae, aristatae, stramineo-flavae, flavae, vel purpureae, pilis subalbidis vel fulvis sparse hirsutae vel dorso glumarum glabrescentes; callus breviter barbatus. *Glumae* subcoriaceae; inferior 12–13-nervis (prope apicem 3–5-nervis apertis), supra medium tenuiter bicarinata, carinis spinulose ciliolatis dentibus minutis vel obscuris terminatis; superior 7-nervis, triente superiore tenuiter carinata, carina scabrida. *Lemmata* moderate ciliata; inferius elliptico-lanceolatum, 5·5 mm. longum, 2-nerve; superius ovatum, 3·5–4 mm. longum, 1–3-nerve, breviter bilobum, arista 12–14 mm. longa praeditum. *Antherae* 3·5 mm. longae. *Caryopsides* (immature) ellipticae, 1·5 mm. longae. *Spiculae pedicellatae* lineari-lanceolatae vel subulatae, plerumque ♂, 6–7 mm. longae, deciduae; gluma inferior 9–12-nervis; gluma superior 6–7-nervis; antherae 3–3·5 mm. longae.

A loosely tufted annual, 50–60 cm. high. *Culms* slender, 1–2 mm. wide, usually simple. *Leaves* few; uppermost sheaths usually clasping the culms and 3–5 times as long as the blades, somewhat pubescent near the nodes and the junction with the blades; ligules membranous, subdeltoid, 2–3 mm. long, hairy at the base; blades narrow, often dagger-shaped, long-acuminate, 4–10 cm. long, 3–9 mm. wide, glabrous, greenish, with a slender paler mid rib. *Panicle* narrow-oblong, 4–12 cm. long, 1–2 cm. wide, long-exserted (8–12 cm.) from the uppermost leaf-sheath; rhachis slender, terete, finely striate; branches 1- to 3-nate, slender, 1–7 cm. long, often bare of spikelets for 1–2 cm. near the base, somewhat hairy near the junction with the rhachis, finely spinulously ciliolate on the branchlets, but otherwise glabrous. *Racemes* 2- to 4-noded, 1–1·5 cm. long; internodes



Sorghum pugionifolium Snowden. A, sessile and pedicelled spikelets; B, lower glume; C, upper glume, exterior view. A, ×5; B and C, ×10. (From *Drummond* 21091.)

and pedicels slender, similar, 2·5–4 mm. long, often somewhat purplish in colour, ciliate with whitish hairs 0·5–1 mm. long. *Sessile spikelets* oblong-lanceolate, acuminate, 5·5–6·5 mm. long, 1·5–2 mm. wide, awned, straw yellow to fulvous or purplish, sparsely whitish or fulvously hairy, at length glabrescent except along the sides; callus shortly bearded. *Glumes* subcoriaceous; lower 12- to 13-nerved (5–6 evident near the tip), with a few cross-nerves about the middle, 2-keeled from near the middle, spinulously ciliolate on the scarious finely marginate keels, which end in minute but sometimes obscure teeth below the hyaline apex; upper 7-nerved, with a few cross-nerves in the upper half, slightly scabrid on the keel in the upper third. *Lemmas* moderately ciliate; lower elliptic-lanceolate, 5·5 mm. long, 1·8 mm. wide, finely 2-nerved; upper elliptic-ovate, 3·5–4 mm. long faintly 1- to 3-nerved, 2-lobed, with an awn 12–14 mm. long. *Anthers* 3·5 mm. long. *Grains* (immature) elliptic, 1·5 mm. long. *Pedicelled spikelets* usually ♂, linear-lanceolate to subulate, 6–7 mm. long; deciduous; lower glume 9- to 12-nerved, upper 6- to 8-nerved; anthers 3–3·5 mm. long.

The type of this species is a specimen in Kew Herbarium, *Drummond* 21,091, collected on 24 October 1886, at Gurgáon, Punjab, India.

Diagnostic characters and affinities

The most significant characters of *S. pugionifolium* are the slender culms, not much over half a metre high; the short, narrow, 'dagger-shaped' leaves, 4–10 cm. long, 3–9 mm. wide; the small panicles 4–12 cm. long, 1–2 cm. wide; and the oblong-lanceolate, acuminate, sessile spikelets, 5·5–6·5 mm. long, 1·5–2 mm. wide, with awns about 12–14 mm. long. This species seems most closely allied to *S. somaliense*, but it differs from that species in the more slender culms, smaller different-shaped leaves, and the oblong-lanceolate, acuminate, sessile spikelets with their thinner subcoriaceous glumes.

Distribution and utility

The type specimen, collected by Drummond at Gurgáon, in the Punjab, India, is the only one I have seen at Kew that belongs to this species and no information is available as to its utility. It is unlikely to prove of much economic value owing to its small size and scanty foliage. It is interesting, however, in its occurrence so far away from the usual distribution of the wild Sorghums belonging to the subsection *Arundinacea*. Its nearest relative and neighbour, *S. somaliense*, from Somaliland, is separated from it by Saudi Arabia, Iran and Baluchistan. As so few Sorghums have been recorded from these areas, however, it seems possible that further records of these two species may eventually come to hand to close the gap at present existing between them.

14. **Sorghum brevicarinatum** Snowden

Sorghum brevicarinatum Snowden, sp.nov.; a *S. verticilliflora* (Steud.) Stapf laminis foliorum latioribus, usuque ad 5 cm. latis, spiculis sessilibus minoribus elliptico-ovatis acutis vel acuminatis 4·5–5·5 mm. longis 2–2·5 mm. latis, gluma inferiore breviore bicarinata carinis latiore marginatis differt.

Gramen annuum vel raro perenne, laxe caespitosum, 1·5–3·5 m. altum. *Culmi* robusti, prope basin 0·5–1 cm. lati, laeves vel tenuiter striati, simplices vel superne ramosi. *Folia* 5–10; laminae lineares, basi latae vel raro tenuiter angustae, in apicem longe acuminatum attenuatae, maturae plerumque 25–85 cm. longae, 2·5–5 cm. latae, prope vaginam et ligulam hirsutae, ceterum glabrae, marginibus superne spinuloso-scabridis, nervo medio pallido prominente infra prope basin. *Panicula* lanceolata, elliptico-lanceolata, vel ovata, laxa, 15–60 cm. longa, 10–25 cm. lata; axis primarius basin versus teres et plerumque laevis, superne canaliculatus angulis nonnunquam spinuloso-scabridis; rami graciles, 1–5-nati, primo suberecti sed mox diffusi, prope basin et axillis ramulorum hirsuti, superne scabridi; inferiores 15–30 cm. longi, basin versus ramosi vel per 5–10 cm. nudati. *Racemi* fragiles, 2–5-nodis, 1–2·5 cm. longi; rhacheos internodia gracilia, 2·5–3·5 mm. longa, pilis fere subalbidis 0·5–1 mm. longis dense ciliata; pedicelli internodiis similes vel nonnunquam graciliores. *Spiculae sessiles* elliptico-ovatae, acutae vel acuminatae, 4·5–5·5 mm. longae, 2–2·5 mm. latae, aristatae, eburneo-flavae, fulvae, vel demum badiae, purpureae, vel nigrae, omnino strigoso-hirsutae vel dorso glumarum demum glabrescentes et nitentes; callus copiose barbatus. *Glumae* aequales, apice subherbaceo excepto, coriaceae; inferior 9–11-nervis, triente superiore breviter bicarinata, carinis late marginatis, spinuloso-ciliolatis, dentibus minutis plerumque terminatis; superior 7-nervis, tertia parte superne acute carinata, carina scabrida. *Lemmata* tenuiter ciliata; inferius elliptico-oblongum vel elliptico-ovatum, 4–5 mm. longum, 2-nerve; superius ovatum vel ovato-ellipticum, 3–4 mm. longum, 3-nerve, breviter bilobum, arista 5–15 (raro 18) mm. longa. *Antherae* 2·5–3 mm. longae. *Caryopsides* obovato-ellipticae vel obovatae, 1·5–3 mm. longae, 1–2 mm. latae, brunneae, rubido-brunneae, vel brunneo-purpurascentes. *Spiculae pedicellatae* linearis vel lineari-lanceolatae, 4–6 mm. longae, ♂ vel plus minusve redactae, deciduae; gluma inferior 8–11-nervis, gluma superior 5–7-nervis; antherae 1·5–2·5 mm. longae.

An annual or rarely a loosely tufted perennial, 1·5–3·5 m. high. *Culms* stout, 0·5–1 cm. wide near the base, smooth or sometimes finely and shallowly striate, simple or branched above, glabrous except near the nodes. *Leaves* 5–10; blades linear, mostly 25–85 cm. long and 2·5–5 cm. wide when mature, from a rather broad or sometimes slightly narrowed base tapering upwards to a fine point, greenish, sometimes rather glaucous, often flushed with brownish to reddish purple, with the paler mid rib prominent below near the base. *Panicle* lanceolate to elliptic-lanceolate or ovate, loose, 15–60 cm. long, 10–25 cm. wide; rhachis terete and more or less smooth below, strongly channelled and sometimes spinulously scabrid on the ridges upwards; branches slender, at first suberect but soon spreading, the lower 2–5 from each node, often 15–30 cm. long, branched near the base or often bare of spikelets for 5–10 cm., hairy near the base and in the axils of the rather widely scattered and scabrid branchlets. *Racemes* fragile, 2- to 5-noded, 1–2·5 cm. long; internodes slender, 2·5–3·5 mm. long, densely ciliate with mostly whitish hairs 0·5–1 mm. long; pedicels similar to the internodes or sometimes rather more slender. *Sessile spikelets* elliptic-ovate, acute or acuminate, 4·5–5·5 mm. long, 2–2·5 mm. wide, cream to tawny or at length mahogany red to maroon or black, permanently whitish strigose or at length glabrous and shining on the backs of the glumes; awned; callus copiously bearded. *Glumes* coriaceous almost throughout but with thinner tips; lower 9- to 11-nerved (with 3–5 nerves obscurely visible between the keels), shortly keeled in the upper third with the broadly margined keels spinulously ciliolate and gradually widening upwards until they terminate in minute teeth below the hyaline apex; upper 7-nerved, sharply keeled in the upper third, scabrid on the keel. *Lemmas* finely ciliate; lower elliptic-oblong to elliptic-ovate, 4–5 mm. long, 2-nerved; upper ovate to ovate-elliptic, 3–4 mm. long, 3-nerved; shortly 2-lobed, with an awn 5–15 (rarely 18) mm. long. *Anthers* 2·5–3 mm. long. *Grains* obovate-elliptic to obovate, 1·5–3 mm. long, 1–2 mm. wide, brownish to reddish brown or brownish purple; embryo-mark more or less obvious. *Pedicelled spikelets* linear to linear-lanceolate, 4–6 mm. long, ♂ or somewhat reduced, deciduous; lower glume 8- to 11-nerved, upper 5- to 7-nerved; anthers 1·5–2·5 mm. long.

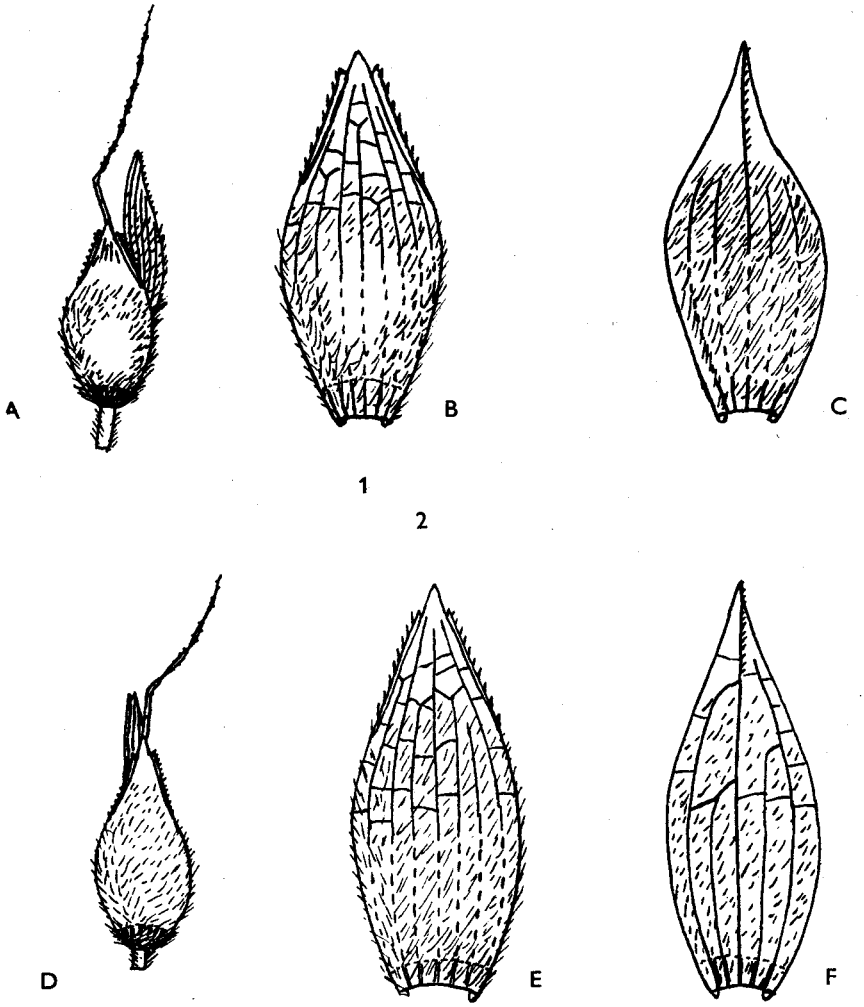
Diagnostic characters and affinities

The distinguishing features of *S. brevicarinatum* are the small elliptic-ovate, acute to acuminate sessile spikelets, 4·5–5·5 mm. long, 2–2·5 mm. wide, with rather short keels which gradually widen upwards to end in more or less distinct minute teeth; and the broad leaves, mostly 2·5–5 cm. wide when mature. It is closely related to *S. verticilliflorum*, but most specimens can be readily separated from the latter species by the smaller elliptic-ovate sessile spikelets, with shorter, usually wider-margined keels, and the broader mature leaves. Intermediate states, such as may sometimes result from cross-fertilization with related species, are more difficult to determine.

Distribution and utility

As far as is at present known the distribution of this species extends from the Tana River in north-eastern Kenya Colony southwards along the coastal districts of Kenya and Tanganyika Territory as far as Useguha and Usagara districts, as well as to most of the nearby islands in the Indian Ocean, including those of Zanzibar, Seychelles, Comoros, Madagascar, and the Mascarenes. Most of the specimens from the mainland of Africa have been collected at low altitudes between 100 and 760 m. above sea-level. The majority of those enumerated below were found growing in or near cultivated lands, often close to the banks of rivers or sometimes in irrigation ditches, generally on alluvial soils or the sticky black soils often referred to as Black Cotton Soils. *S. brevicarinatum* readily intercrosses with the varieties of grain Sorghums cultivated in the districts where it is found, especially varieties of *S. roxburghii*. The grains of the wild plants are some-

times eaten by the natives in times of famine. No information is available regarding its use as fodder for domestic animals, but it should have about the same value as *S. verticilliflorum*, with which it has hitherto been identified. It may prove more suitable than the latter species for hot humid districts, as it would appear to have adapted itself more particularly to such conditions. There is no evidence on record as to its particular toxic properties, but these are not likely to differ much from the related *S. verticilliflorum*.



(1) *Sorghum brevicarinatum* var. *brevicarinatum* Snowden. A, sessile and pedicelled spikelets; B, lower glume; C, upper glume, exterior view. (From *Sampson* 99.) A, × 5; B and C, × 10. (2) *S. brevicarinatum* var. *swahilorum* Snowden. D, sessile and pedicelled spikelets; E, lower glume; F, upper glume, exterior view. D, × 5; E and F, × 10. (From *Sampson* 43.)

(i) Var. **brevicarinatum**

Var. **brevicarinatum**, based on *S. brevicarinatum* Snowden.

Sessile spikelets elliptic-ovate, acute, 4·5–5 mm. long; lower glume distinctly 2-keeled with the margins of the keels widening upwards to end in minute but distinct teeth; pedicelled spikelets often reduced, usually neuter, rarely ♂ with the anthers small.

The type of this variety is the same as that of the species, namely a specimen in Kew Herbarium, *Storey* 2, collected in Tanganyika Territory, on the Muhesa–Amani Road, at an altitude of 240 m.

KENYA COLONY. Tana River district, at Taneka, 760 m., *Sampson* 99!

TANGANYIKA TERRITORY. Usambara district, Muhesa–Amani Road, 240 m., *Storey* 2! Usagara district, Kilosa, *Burtt* 138!

A specimen from Wagamoya near Tongwe, *Storey* 12! which is damaged by 'Smut disease', probably belongs here.

ZANZIBAR. Wanda country, *Taylor* 93B! Yozani, near Pandanus forest, *Greenway* 1343! Without precise locality, *Vaughan* 1899!

SEYCHELLE ISLANDS. Mahé Island: *Neville*! *Thomasset*! Silhouette Island: *Gardiner*! Praslin Island: *Dupont*!

COMORO ISLANDS. Johanna Island, *Hildebrandt* 1716!

MADAGASCAR. Central Madagascar, *Baron* 2385! 4568! Nosi Bé, collected 1849, *Boivin* 1987!

RODRIGUEZ. Without precise locality; collected 1864–5, *Bouton* G73! Collected 1874, *Balfour*!

SOUTH AFRICA. Transvaal Province: Doornkloof, Irene, *Pole Evans* 337! This specimen was probably grown from introduced seed.

(ii) Var. **swahilorum** Snowden

Var. **swahilorum** Snowden, var.nov.; Spiculae sessiles elliptico-ovatae, acuminatae, 5–5·5 mm. longae; gluma inferiore moderate bicarinata, carinis sine dentibus vel in dentibus obscuris terminatis; spiculae pedicellatae plerumque ♂, antherae 1·5–2·5 mm. longae.

Sessile spikelets elliptic-ovate, acuminate, 5–5·5 mm. long; lower glume 2-keeled with the keels ending without teeth or obscurely toothed; pedicelled spikelets usually ♂, anthers 1·5–2·5 mm. long.

The type of this variety is *Greenway* 1956 in Kew Herbarium. It was collected in the Usambara district of Tanganyika Territory, at Tengeni, at an altitude of 210 m.

KENYA COLONY. Teita district, Voi, 610 m., *McDonald* 852! Malindi district, Chonyi, 270 m., *Taylor* 1219! Tana River district, Ngwena, *Sampson* 43!

TANGANYIKA TERRITORY. Arusha district, Mgaruki, *St Clair Thompson* 298! Usambara district: Tanga, *Holst* 2342! Lunguza, up to 600 m., *Greenway* 766 (sheet 1)! Tengeni, 210 m., *Greenway* 1956! Korogwe, in the Luengera valley, 450 m., *Davis* 1003! Useguha district, Morogoro, 450 m., *Rounce* 489! Mahenge district, 270–305 m., *Schlieben* 1710! Without precise locality, *Busse* 140!

The second sheet of *Greenway* 766 has been damaged by a 'Smut disease'.

COMORO ISLANDS. Mohilla Island, collected 1861, *Kirk*!

RÉUNION (BOURBON). Without precise locality, collected 1846, *Boivin* 991!

MAURITIUS. In forests, collected 1864–5, *Bouton*!

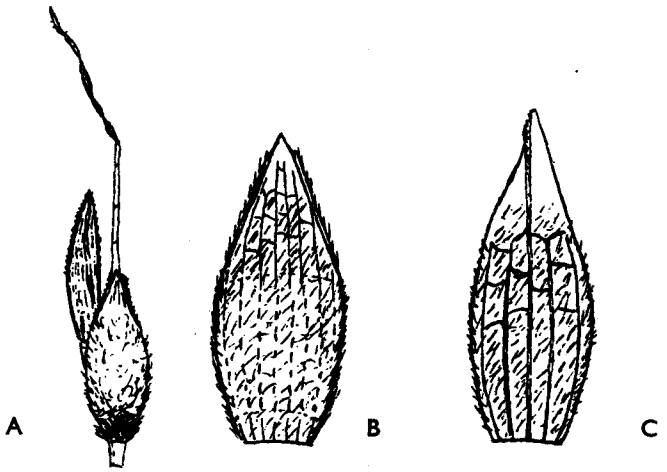
JAVA. Cultivated at Pasoervean, introduced from Amani, Tanganyika Territory, *Posthumus* 8 (3245)!

15. **Sorghum usambarense** Snowden

Sorghum usambarense Snowden, sp.nov.; affine *S. verticilliflоro* (Steud.) Stapf et *S. brevicarinato* Snowden, ab illo laminis foliorum latioribus 3–5 cm. latis, panicula profusiore ramosa, spiculis sessilibus minoribus elliptico-lanceolatis vel elliptico-oblongis obtusis vel subacutis 4·5–5·2 mm. longis 1·5–2 mm. latis, ab hoc ramis paniculae gracilioribus magis numerosis, spiculis sessilibus angustioribus elliptico-lanceolatis vel elliptico-oblongis obtusis vel subacutis 1·5–2 mm. latis differt.

Gramen laxe caespitosum, 2–3·5 m. altum, perenne. *Culmi* validi, usque ad 1 cm. lati,

simplices vel superne ramosi, ad nodos pubescentes ceterum glabri. *Folia* numerosa; laminae lineares, e basi magis minusve contractae, longe in apicem tenuem attenuatae, 25–75 cm. longae, 3–5 cm. latae, ad margines serrulato-scaberrimae, costa media virido-albida superne gradatim tenuiter attenuata. *Panicula* laxa, lanceolata vel elliptico-lanceolata, 30–60 cm. longa, 10–15 cm. lata; axis primarius canaliculatus, angulatus, ad angulos spinuloso-scabridus; rami numerosi, parte basali excepta gracillimi, flexuosi et nutantes, superne ut ramuli scaberrimi, prope basin et axillis ramulorum hirsuti, inferiores plerumque 5–6-nati, 15–28 cm. longi, basin versus per 5–10 cm. nudati. *Racemi* fragiles, 2–5-nodis, 1–2 cm. longi; rhacheos internodia gracilia, 2–3·5 mm. longa, pilis plerumque rufis 0·5–1 mm. longis dense ciliata; pedicelli internodiis similes. *Spiculae sessiles* elliptico-lanceolatae vel elliptico-oblongae, obtusae vel subacutae, 4·5–5·2 mm. longae, 1·5–2 mm. latae, aristatae, stramineo-flavae vel fulvae, demum rubido- vel brunneo-purpureae, pilis fulvis, rufis vel purpureis dense strigosae, vel interdum dorso glumarum glabrescentes; callus dense barbatus. *Glumae* aequales, parte apicali et prope



Sorghum usambarense Snowden. A, sessile and pedicelled spikelets; B, lower glume; C, upper glume, exterior view. (From *Eichinger* G 5885.) A, × 5; B and C, × 10.

callum excepta, coriaceae; inferior plerumque 11-nervis, supra medium tenuiter bicarinata, carinis breve spinuloso-ciliolatis plerumque dentibus minutis terminatis; superior dorso anguste convexo, 7-nervis (2–4-nervis brevis), apicem versus acute carinata, carina scabrida. *Lemmata* tenuiter ciliata; inferius elliptico-lanceolatum, 4·3–4·8 mm. longum, plerumque 2-nerve; superius ovatum vel ovato-ellipticum, 3–3·5 mm. longum, 3-nerve, breviter bilobum, arista 12–15 mm. longa. *Lodiculae* sparse ciliolatae vel paene glabrae. *Antherae* 3 mm. longae. *Caryopsides* (immaturae) ellipticae vel obovato-ellipticae, circiter 1·5 mm. longae et 0·8 mm. latae, rubido-brunneae. *Spiculae pedicellatae* lineari-lanceolatae vel subulatae, 4·5–5·5 mm. longae, ♂, deciduae; gluma inferior 9–11-nervis, gluma superior 5–7-nervis; antherae 2–3 mm. longae.

A loosely tufted short-lived perennial, 2–3·5 m. high. *Culms* stout, up to 1 cm. wide, simple or branched above, glabrous except for the pubescent nodes. *Leaves* many; blades linear, 25–75 cm. long, 3–5 cm. wide, from a rounded and somewhat constricted base, gradually narrowing upwards to the finely pointed apex, with the greenish white mid rib gradually becoming very fine near the tip, and the margins serrulately scabrid almost to the base. *Panicle* loose, lanceolate to elliptic-lanceolate, 30–60 cm. long, 10–15 cm. wide; rhachis channelled and angular, usually coarsely spinulously scabrid on the ridges, especially in the upper half; branches numerous, very slender and flexuous with the tips soon drooping, the lower usually 5–6 from each node, 15–28 cm. long, often

naked for 5–10 cm. from the base, very rough upwards like the branchlets, hairy at the base and in the axils of the divisions. *Racemes* fragile, 2- to 5-noded, 1–2 cm. long; internodes and pedicels slender, 2–3·5 mm. long, densely ciliate with usually rufous hairs 0·5–1 mm. long. *Sessile spikelets* elliptic-lanceolate to elliptic-oblong, obtuse or subacute, 4·5–5·2 mm. long, 1·5–2 mm. wide, awned, straw yellow to fulvous or at length reddish to brownish purple, usually densely strigose with tawny to rufous or purplish hairs, but sometimes glabrous on the backs of the glumes; callus densely bearded. *Glumes* coriaceous, but slightly thinner near the tips and just above the callus; lower usually with 11 primary nerves (3–4 nerves evident near the tip), keeled from a little above the middle with the narrow linear margins of the keels usually ending in minute teeth below the rather short hyaline tip, shortly spinulously ciliolate on the keels; upper narrowly convex, 7-nerved, with 2–4 of the inner lateral ones usually rather short, sharply keeled and scabrid towards the tip. *Lemmas* finely ciliate; lower elliptic-lanceolate, 4·3–4·8 mm. long, usually 2-nerved; upper ovate to ovate-elliptic, 3–3·5 mm. long, 3-nerved, shortly 2-lobed, awn 12–15 mm. long. *Lodicules* sparsely ciliolate or almost glabrous. *Anthers* 3 mm. long. *Grains* (immature) elliptic to obovate-elliptic, about 1·5 mm. long and 0·8 mm. wide, reddish brown. *Pedicelled spikelets* linear-lanceolate to subulate, 4·5–5·5 mm. long, ♂, deciduous; lower glume 9- to 11-nerved, upper 5- to 7-nerved; anthers 2–3 mm. long.

This species is based on specimens collected in the Usambara district of Tanganyika Territory. Of these I have selected *Eichinger* G5885 in Kew Herbarium as the type.

Diagnostic characters and affinities

The chief characters which serve to distinguish this species are the broad leaves, 3–5 cm. wide when mature, the large loose panicle with long slender branches in clusters often 5–6 or more from a node, and the small narrow elliptic-lanceolate to elliptic-oblong sessile spikelets, 4·5–5·2 mm. long, 1·5–2 mm. wide, with obtuse to subacute tips. *S. verticilliflorum* var. *infrequens* is the species most closely related to it, especially in the size and colouring of the sessile spikelets, but these are somewhat larger and the tips more acuminate than in those of *S. usambarense*. The latter also differs in the broader leaves as well as usually having a larger panicle with longer slender branches often 5–6 or more from each of the lower nodes. *S. usambarense* is easily separated from the related broad-leaved *S. brevicarinatum* by the narrow elliptic-lanceolate to elliptic-oblong sessile spikelets.

Distribution and utility

S. usambarense has so far been recorded only from the warmer parts of the Usambara district of Tanganyika Territory, within a short distance of Amani. It appears to be confined mainly to cultivated lands such as are abandoned and become overgrown, especially those near rivers. There is no evidence of its cultivation for fodder, but it would appear to be of about the same value for that purpose in hot humid districts as *S. brevicarinatum*.

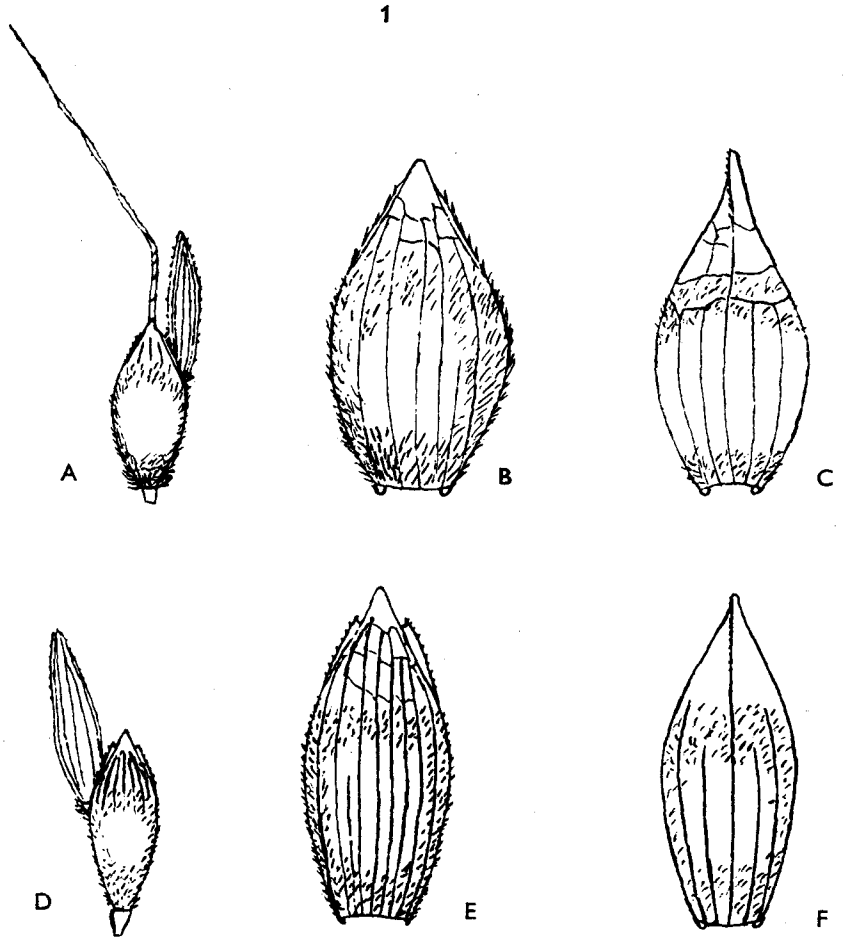
Tanganyika Territory. Usambara district: Amani, in the warmer parts of old cultivations, *Eichinger* G5885! 7642! s.n.! Near the Kihuku River, a 12 ft. high tussock grass, *Greenway* 3245!

16. **Sorghum castaneum** C. E. Hubbard et Snowden

Sorghum castaneum C. E. Hubbard et Snowden in *Kew Bull.* p. 316, 1936. The basis of this species is a specimen in Kew Herbarium, collected in the Toro district of Uganda, at Bubandi, 1050 m., in Elephant Grass country, *Thomas* 714.

Description

A loosely tufted perennial up to about 2·5 m. high. *Culms* stout, up to 8 mm. wide near the base, simple or branched. *Leaves* 6–7 or more; blades linear, from a broad base tapering to a pointed apex, up to 40 cm. long, 1·5–2·7 cm. wide, green, sometimes slightly glaucous, blotched with purplish colouring. *Panicle* lanceolate- to ovate-oblong, about 40 cm. long and 10–15 cm. wide, loose; rhachis somewhat angular and widely grooved,



(1) *Sorghum castaneum* C. E. Hubbard et Snowden. A, sessile and pedicelled spikelets; B, lower glume; C, upper glume, exterior view. (From *Thomas* 714.) (2) *S. panicoides* Stapf. D, sessile and pedicelled spikelets; E, lower glume; F, upper glume, exterior view. (From *Figari*, Abyssinia.) A and D, ×5; B, C, E and F, ×10.

densely hairy at the nodes; branches 2–4 or sometimes solitary, slender, flexuous, hairy in the axils of the divisions, scabrid upwards, the lower ones up to 20 cm. long, usually bare of spikelets for 5 cm. or more from the hairy base. *Racemes* fragile, 2- to 5-noded, up to 15 mm. long, internodes and pedicels slender, 2–3·5 mm. long, densely ciliate with fulvous hairs. *Sessile spikelets* broadly elliptic to elliptic-oblong, obtuse, 4–4·5 mm. long, 2–2·5 mm. wide, chestnut to dark brown or brownish black, permanently hirsute or

glabrescent on the backs of the glumes, awned; callus shortly bearded. *Glumes* coriaceous with slightly thinner tips; lower at length slightly bulging in the lower half, 8- to 11-nerved (with about 3 nerves visible near the tip), cross-nerves few and obscure, 2-keeled in the upper third, spinulously ciliolate on the finely margined keels which merge into the hyaline apex or rarely end in obscure teeth near the tip; upper glume strongly convex, 7-nerved, with the inner lateral ones short, a few faint cross-nerves above the middle, sharply keeled near the tip, usually scabrid on the keel. *Lemmas* finely ciliate; lower elliptic-ovate or elliptic, 4–4·3 mm. long; upper ovate to ovate-oblong, 3 mm. long, shortly bilobed, awn 9–12 mm. long. *Anthers* 2·5 mm. long. *Grains* obovate to obovate-rotund, 2–2·5 mm. long, 1·5–1·7 mm. wide, brownish purple; embryo-mark obscure to distinct. *Pedicelled spikelets* 4–4·5 mm. long, ♂ or sometimes reduced, tardily deciduous; lower glume 8- to 9-nerved, upper 5- to 8-nerved; anthers small.

Diagnostic characters and affinities

S. castaneum may be recognized by the small broadly elliptic to elliptic-oblong sessile spikelets 4–4·5 mm. long, 2–2·5 mm. wide, with obtuse tips, usually hairy and chestnut to dark brown or brownish black in colour. It has narrow leaves resembling those of *S. verticilliflorum*, but from this species it is easily separated by its smaller, broad, obtuse sessile spikelets, the lower glume fewer-nerved, and the upper glume with shorter inner lateral nerves. The narrow leaves serve to distinguish *S. castaneum* from the broad-leaved *S. brevicarinatum* and *S. usambarense*, but in addition the sessile spikelets are smaller, broader elliptic, and more obtuse than the former, and are wider than the latter, whilst the fine keel-margins usually merge into the hyaline apex without distinct teeth.

Distribution and utility

No further specimens to match this interesting species have been received since the original gathering and it would appear that its distribution may be confined to the Bwamba area of the Toro district. This lies to the west of the Ruwenzori mountains, in the valley of the River Semliki, adjoining the Belgian Congo, which is reputed to be unhealthy, sparsely populated by the natives, and seldom visited by Europeans. It seems possible that *S. castaneum* may have originated from cross-fertilization between *S. verticilliflorum* and the local cultivated grain Sorghums, which belong mainly to *S. nigricans*, which it somewhat resembles in the smallness and shape of the sessile spikelets. On the other hand, it may be one of the primitive types from which *S. nigricans* has been evolved. *S. castaneum* is said to be frequent in areas where Elephant Grass (*Pennisetum purpureum* Schumach.) is prevalent, which suggests a preference for a habitat where there is an evenly distributed rainfall and a well-drained fertile soil. Its utility is probably somewhat similar to that of *Sorghum verticilliflorum*, although up to now it does not appear to have been specially cultivated for use as fodder, but is grazed by wild and domestic animals in the localities where it grows naturally.

Uganda. In Bwamba county of Toro district, at Bubandi, 1050 m., *Thomas* 714!

17. **Sorghum panicoides** Stapf

Sorghum panicoides Stapf in Prain, *Fl. Trop. Afr.* **9**, 120, 1917, is based on a specimen collected in eastern Abyssinia by *Figari*, the type specimen being in Kew Herbarium.

Description

Probably an annual, but base unknown. *Culms* 3·5 mm. thick just below the panicle. *Leaves* few (only the uppermost seen); ligule about 2 mm. long, fringed with stiff hairs; blades linear, from a fairly wide base tapering upwards to the acuminate tip, about 35 cm. long, 1·5–2 cm. wide, green, but with reddish colouring towards the margins,

hairy behind the ligule, mid rib stout below. *Panicle* narrowly oblong to oblong-lanceolate, 20–25 cm. long, 6 cm. or more wide, somewhat contracted or loose; branches suberect or spreading, very slender and flexuous, the lower several in a whorl, up to 15 cm. long, often bare for 1–6 cm. from the hairy base or sometimes undivided for half their length, very finely scabrid above, almost smooth below. *Racemes* up to 5-noded and 2 cm. long; internodes and pedicels very slender, 3–3·5 mm. long, ciliate with whitish hairs 0·5–0·75 mm. long. *Sessile spikelets* elliptic to elliptic-oblong, subacute, 4–5 mm. long, 1·5–2 mm. wide, dull cream to buff yellow with 4–5 nerves visible in the upper half of the lower glume when young, sparsely hairy with whitish hairs, especially near the base, above the middle, and along the sides, awnless; callus moderately bearded with whitish hairs 1 mm. long. *Glumes* thinly coriaceous up to the middle, very thin and papery above; lower usually 11-nerved, with a few faint cross-nerves towards the tip, shortly 2-keeled in the upper third, with the narrow margins widening upwards to end in minute teeth, forming with the hyaline apex a distinctly 3-toothed tip; upper delicately 7- to 8-nerved, with the inner lateral ones rather short, cross-nerves absent or obscure, finely keeled and scabrid on the keel in the upper fourth. *Lemmas* thinly ciliate; lower elliptic- to oblong-lanceolate, 4–4·5 mm. long; upper ovate, 3 mm. long, subentire, 1- to 3-nerved, with a small mucro up to 0·5 mm. long. *Anthers* 2·5–3 mm. long. *Ovary* elliptic, mature grains unknown. *Pedicelled spikelets* 4·5–6 mm. long, ♂, deciduous; lower glume 7- to 8-nerved, upper 6- to 7-nerved; anthers 2·5–2·8 mm. long.

Diagnostic characters and affinities

The distinguishing characters of *S. panicoides* are the narrow elliptic to elliptic-oblong, subacute sessile spikelets, 4–5 mm. long, 1·5–2 mm. wide, the unusually thin glumes with the nerves of the lower glume outwardly visible to the middle, the short keels of the lower glume with the narrow margins widening upwards to end in minute teeth and form with the hyaline apex a distinctly 3-toothed tip, and the awnless upper lemma. It does not appear to be closely related to any of the other species in this subsection *Arundinacea*, differing from them all in the thinner glumes and the upper lemma with a very small mucro. The thinner glumes, the lower usually with 11 or more primary nerves, also separate it from most of the awnless forms of the subsection *Halepensia*, particularly those of *S. halepense*, which it somewhat resembles in the size and shape of the sessile spikelets. The absence of the base of the culm, and mature leaves from the centre of the culm, as well as of mature grains, add to the difficulties of determining the relationship of this species.

Distribution and utility

No other specimens have been identified with *S. panicoides* except the original plant collected in Abyssinia. It does not appear to have been grown for fodder or to have any special merit for this purpose.

Abyssinia. In east Abyssinia, without precise locality or number, *Figari*!

Piper (in *Proc. Biol. Soc. Wash.* **28**, 29, 1915) mentions the above specimen in a note under *Andropogon halepensis muticus*, but Stapf (in Prain, *Fl. Trop. Afr.* **9**, 120, 1917) evidently considered it to be an annual and a distinct species (belonging to the subsection *Arundinacea*). After careful examination of the scanty material available at Kew I find no reason to disagree with Stapf's conclusions.

18. **Sorghum hewisonii** (Piper) Longley

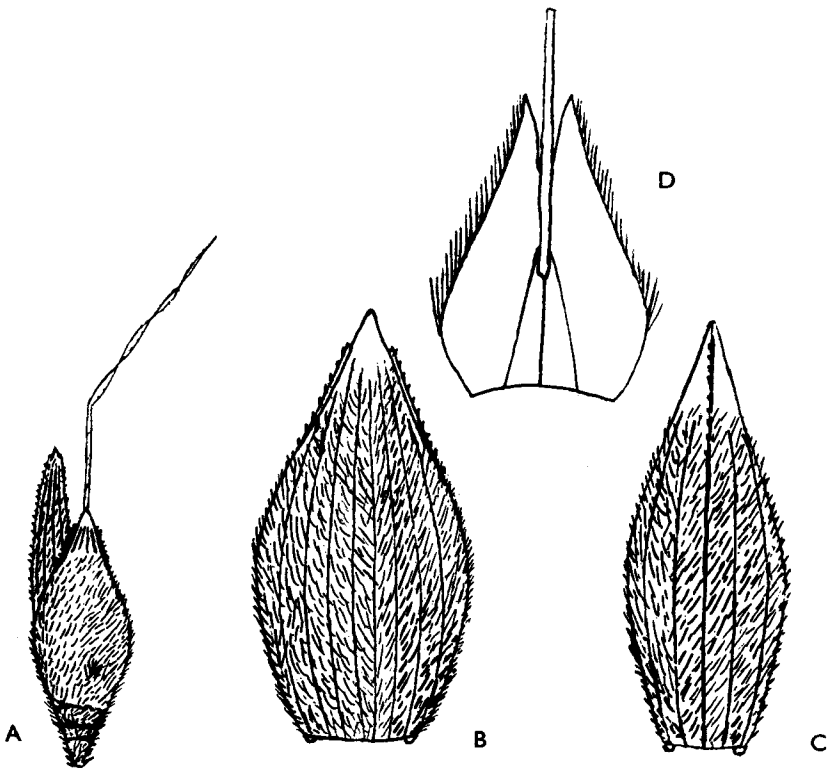
Andropogon sorghum hewisoni Piper in *Proc. Biol. Soc. Wash.* **28**, 41, 1915, is founded on a specimen, grown in the United States, which was raised from seed collected by Hewison from wild plants in the Sennar district of the Blue Nile province, in the Anglo-Egyptian Sudan. I have not been able to see the type, which Piper states was grown in

a greenhouse, but I have examined an authentic specimen, ex *U.S. Dep. Agric. Sorghum Herb. S.P.I.* 33,739, collected by Reed on 31 Oct. 1916, which was raised at Chula Vista, California, from the same batch of seed as the type specimen.

Sorghum hewisonii (Piper) Longley in *J. Agric. Res.* **44**, 318, 319, 1932. This name was used by Longley in an account of the chromosomes of grass Sorghums. It is based on *A. sorghum hewisoni* Piper.

Description

A vigorous loosely tufted perennial, 2–3·5 m. high. *Culms* stout, 1–3 cm. wide near the base, solitary or few to many from the basal rootstock, simple or branched above, often coated with a thin waxy bloom. *Leaves* numerous, 12–20; sheaths mostly longer than



S. hewisonii (Piper) Longley. A, sessile and pedicelled spikelets; B, lower glume; C, upper glume, exterior view; D, upper lemma with lower part of awn. (From *U.S. Dep. Agric. Sorghum Herb. S.P.I.* 33,739.) A, ×5; B–D, ×10.

the internodes; blades 0·7–1 m. long, 4–8 cm. wide, from a broad rounded base, narrowing upwards into a pointed apex, with the broad mid rib prominent below in the lower half. *Panicle* oblong to somewhat fusiform, dense and sometimes more or less compact, 10–20 cm. long, 3–8 cm. wide; rhachis often completely hidden by the branches and spikelets, channelled below, somewhat angular upwards, tomentose to hirsute; branches crowded, usually many from each node, rather stiff and suberect, the lower 5–10 cm. long, furnished with spikelets up to, or almost up to, the silkily hairy base. *Racemes* tough or tardily disintegrating, mostly 1- to 3-noded and 8–20 mm. long, internodes and pedicels rather slender to somewhat stout, 2–4 mm. long, densely ciliate with usually whitish hairs about 1 mm. long. *Sessile spikelets* ovate to broadly elliptic-ovate, acute to acuminate, 6–7·5 mm. long, 2·5–3·5 mm. wide, with about 4 greenish nerves

visible between the keels of the lower glume when young, mostly straw yellow to deep cream or tawny, but sometimes chestnut red to maroon, usually densely strigose with fulvous to tawny or rarely pale purplish hairs, awned; callus bearded with hairs about 1 mm. long. *Glumes* firmly coriaceous but somewhat thinner near the tip where the nerves are obscurely visible; lower 11- to 15-nerved, often with obscure transverse nerves in the upper third or half, obscurely 2-keeled in the upper third and spinulously ciliolate on the narrow linear margins which end in minute teeth or merge gradually into the hyaline tip; upper 7-nerved, often with obscure cross-nerves in the upper half, scabrid on the keel in the upper third. *Lemmas* densely ciliate; lower elliptic-lanceolate to elliptic-oblong, 5–6·5 mm. long; upper ovate, 4–5 mm. long, 2-lobed to 0·5 or 1 mm. deep, awn 10–18 mm. long. *Anthers* 3–4 mm. long. *Grains* obovate-elliptic, 3·5–4·5 mm. long, 2·5–3 mm. wide, brownish yellow or light to dark reddish brown; embryo-mark distinct. *Pedicelled spikelets* 5–7 mm. long, ♂ or somewhat reduced, of similar colour to the sessile, usually persistent; lower glume 8- to 13-nerved, upper 5- to 10-nerved; anthers 2·5–3·5 mm. long.

Diagnostic characters and affinities

The broad leaves, 4–8 cm. wide; dense, sometimes more or less compact, panicle; somewhat tough racemes; and the large broadly elliptic-ovate to ovate, acute to acuminate, very hairy sessile spikelets, 6–7·5 mm. long, 2·5–3·5 mm. wide, are the most distinctive features of *S. hewisonii*. In the shape and hairiness of the sessile spikelets it is closely related to *S. aethiopicum*, but it is readily separated from the latter species by the taller, stouter culms; larger, wider leaves; more compact densely branched panicles; tougher racemes; and shorter awns. I do not think that it is closely related to any of the other wild Sorghums, but Piper (loc. cit) suggests that it is allied to specimens collected in the Anglo-Egyptian Sudan by *Brown* that were later referred by Stapf to *S. lanceolatum*. The lanceolate sessile spikelets, loose panicles and narrow leaves of this latter species, however, enable it to be easily distinguished from *S. hewisonii*.

Distribution and utility

Specimens of *S. hewisonii* have been found growing wild in the Anglo-Egyptian Sudan and its distribution may also extend into Abyssinia and Somaliland. In the United States, where seeds were introduced from the Anglo-Egyptian Sudan, Piper states that at Arlington Farm, Virginia, the plants grew 2–2½ m. high but did not bloom before frosts occurred and prevented further growth. This suggests that it either requires a long growing season or a hotter climate than that of Virginia, which may account for the fact that it does not appear to have been extensively grown in the United States. Nor is there any evidence of its having been cultivated for fodder in the Anglo-Egyptian Sudan, although its stout culms, furnished with abundant broad leaves, and its tough racemes, enabling the seed to be harvested without much loss, make it well suited for trial as a fodder crop in countries with a hot climate. The wild specimens have generally been found in or near to cultivated lands and the plants resemble a cultivated race more than a wild one.

Anglo-Egyptian Sudan. Darfur province, Shankletebiya, on Fasher–Nyala Road, *Harrison* 205! White Nile province, Degain and Tendelai, *Andrews* 1! 4! Makwar, Sept.–Dec. 1929 (Sheet 1) *Punter*! Seed from Khartoum (grown at Chula Vista, California), ex *U.S. Dep. Agric. Sorghum Herb. S.P.I.* 33,739!

Vern. names: Addar, Adar (Arabic).

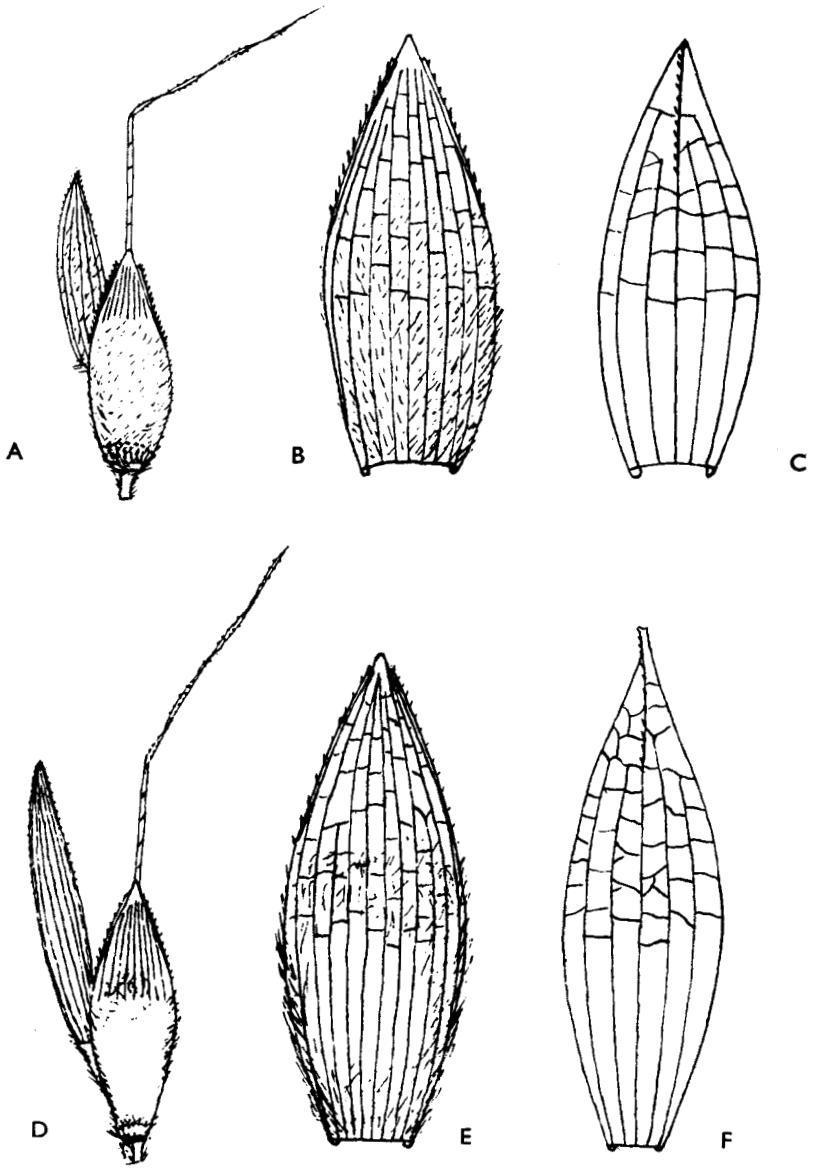
Eritrea. A specimen from Bogos, Cheren Dari, 1360 m. (ex Herb. R. Horti Romani) *Fiori* 1230! may belong here, but the material is inadequate for exact determination.

Somaliland. Without precise locality, *Collenette* 159!

This specimen has small somewhat immature spikelets but otherwise agrees well with *S. hewisonii*.

19. **Sorghum sudanense** (Piper) Stapf

Andropogon sorghum subsp. *sudanensis* Piper in *Proc. Biol. Soc. Wash.* **28**, 33, 1915, the basis of this species, was founded on a specimen grown in Virginia, United States of America, which was raised from seed obtained from the Anglo-Egyptian Sudan. Although



Sorghum sudanense (Piper) Stapf. A and D, sessile and pedicelled spikelets; B and E, lower glume; C and F, upper glume, exterior view. (A–C, from *U.S. Dep. Agric. Sorghum Herb.* ex. *Piper*; D–F, from *Potts* 2897.) A and D, ×5; B, C, E and F, ×10.

I have not been able to see the type specimen, I have examined specimens grown at Arlington Farm, Virginia, raised from the same sample of Sudan seed as the type, that were sent to Kew by Piper, besides several others specimens at Kew determined by Piper as *Andropogon sorghum sudanesis*.

Holcus sorghum subsp. *sudanensis* (Piper) Hitchc. in *Proc. Biol. Soc. Wash.* **29**, 128, 1916, is a change of name, based on Piper's subspecies.

Sorghum sudanense (Piper) Stapf. in Prain, *Fl. Trop. Afr.* **9**, 113, 1917, is based on *Andropogon sorghum sudanensis* Piper.

Holcus sudanensis (Piper) Bailey, *Gentes Herb.* **1**, 132, 1923, has the same basis.

Andropogon sudanensis (Piper) Leppan & Bosman, *Field Crops of South Africa*, p. 286, 1923, is based on Piper's subspecies and gives it specific rank under the genus *Andropogon*.

Sorghum vulgare var. *sudanense* (Piper) Hitchc. in *J. Wash. Acad. Sci.* **17**, 147, 1927, is a change of name made on reducing Piper's subspecies to a variety of *Sorghum vulgare* Pers.

Description

An annual 1·5–3 m. high, or sometimes persisting as a loosely tufted perennial. *Culms* rather slender, about 3–6 mm. wide near the base, solitary or often several to many arising together from the basal rootstock. *Leaves* up to 9 or more; sheaths densely pubescent near the base; blades narrow linear, attenuated towards the base, 15–50 cm. long, 8–12 (rarely 15) mm. wide, narrowing upwards to a sharp point, dull to bright green, often blotched with purple, mid-rib rather stout and striate. *Panicle* ovate to pyramidal, very loose, 15–30 cm. long, 8–15 cm. broad; rhachis channelled and rough on the ridges upwards; branches ascending, soon spreading, slender and flexuous, the lower 2–5 from each node, 5–15 cm. long, often bare for 1–5 cm. from the almost glabrous base, spinulously scabrid upwards like the branchlets. Racemes usually tough, 2- to 5-noded, 1·5–2·5 cm. long; internodes slender, 2·5–4 mm. long, ciliate with whitish to fulvous or pale purplish hairs 0·5–0·75 mm. long; pedicels similar or sometimes a little shorter. *Sessile spikelets* elliptic to elliptic- or oblong-lanceolate, subacute, 6–7·5 mm. long, 2–3 mm. wide, pale straw or buff yellow to tawny, with about 5 greenish nerves visible between the keels of the lower glume when young, at length sometimes purplish to almost black, sparingly whitish to purplish strigillose but usually glabrous and shining on the backs of the glumes when mature, awned; callus beard scanty to moderate. *Glumes* coriaceous up to the middle or somewhat above the middle, thinner upwards; lower 11- to 15- (mostly 13-)nerved, with cross-nerves in the upper half, 2-keeled from just above the middle, obscurely margined or with the fine linear margins ending without or with only obscure teeth just below the short hyaline tip, spinulously ciliolate on the keels; upper 7-nerved, with cross-nerves from near the tip to below the middle, scabrid on the sharp keel in the upper fourth. *Lemmas* finely long-ciliate; lower elliptic-lanceolate to elliptic-oblong, 5–6·5 mm. long; upper ovate to ovate-elliptic, 3·5–4·5 mm. long, 2-lobed to 0·5 or 1 mm. deep, awn 10–16 mm. long. *Anthers* about 4 mm. long. *Grains* elliptic to obovate-elliptic, yellowish to tan 3·5–4·5 mm. long, 1·5–2 mm. wide; embryo-mark usually distinct. *Pedicelled spikelets* persistent, ♂ or sometimes neuter, 5·5–8 mm. long, greenish straw colour to tawny or purplish; lower glume 9- to 11-nerved, upper 7- to 9-nerved; anthers 3–4 mm. long.

Diagnostic characters and affinities

S. sudanense may be recognized by the narrow leaves; loose spreading panicle with tough racemes; persistent sessile and pedicelled spikelets, the sessile almost elliptic or elliptic- to oblong-lanceolate, subacute, 6–7·5 mm. long, 2–3 mm. wide, with awns 10–16 mm. long. It is probably most closely related to *S. lanceolatum* and *S. virgatum*, but it also resembles *S. verticilliflorum*. It can be distinguished from all of them by the tough racemes with persistent sessile and pedicelled spikelets, as well as by the shape of the sessile spikelets, which are broader in the upper half, more elliptic in outline, and subacute. The grains of *S. sudanense* are also comparatively large and usually rather long and narrow.

Distribution and utility

The natural distribution of *S. sudanense* seems to be confined to Egypt and the Anglo-Egyptian Sudan, although it does not appear to be common as a wild plant in either country, as comparatively few wild specimens have been recorded. Early in the twentieth century it was introduced into America. According to Piper (in *Proc. Biol. Soc. Wash.* **28**, 33, 1915) seeds from Khartoum, in the Anglo-Egyptian Sudan, were sent to the United States by Hewison. The resulting plants were successfully grown and after trial proved to be suitable as fodder for stock. Under the name of Sudan Grass the species was afterwards distributed and cultivated in many parts of the country. Since that time it has been introduced into many other countries, including those of South America, South Africa, and Australia, and is now extensively grown for feeding domestic animals. In the United States, where it is generally treated as an annual plant, if given enough room, it tillers freely and may produce as many as 100 stems from one crown. These tiller-shoots are most numerous after the first crop has been reaped and in consequence the hay obtained from the second cutting is often finer than that of the first. The absence of perennial rhizomes makes *S. sudanense* more suitable as a fodder crop than *S. halepense*, as the latter has proved to be a troublesome weed in many cultivated lands because of the difficulty in eradicating the rhizomes when the land is needed for other purposes. The tough racemes of *S. sudanense* make it possible to harvest the crop with little loss of seed, and this is another factor that has led to its replacing Johnson Grass (*S. halepense*) as a fodder crop in many countries where Sorghums are grown for feeding stock. *S. sudanense* readily intercrosses with cultivated Sorghums when grown in close proximity to them, especially with the sweet-stemmed varieties belonging to *S. bicolor* and *S. dochna*. Such hybrids have often been recorded in the United States as well as in Australia, but they are usually easily distinguished from the typical *S. sudanense* by their wider leaves and stouter culms.

S. sudanense is regarded as poisonous to stock under certain conditions. The HCN content is not constant, however, and is affected by drought, stunted growth, and frost damage, as well as by insect and fungous attack. According to Hurst (in *The Poison Plants of New South Wales*, 1942) it contains about two-fifths as much HCN as is found in the cultivated grain Sorghums. Swanson (in *J. Agric. Res.* **22**, 125–38, 1921; *J. Amer. Soc. Agron.* **5**, 13, no. 1, 33–36, 1921) dealing with hydrocyanic acid in Sudan Grass, found that although large amounts of the acid were generally present in Sudan Grass used for pasture no harm resulted to the cattle. The liberation of the acid was associated with enzyme action. Slow drying caused the hydrocyanic acid to disappear but making Sudan Grass into silage did not diminish the amount of acid present. Freshly frosted plants that were tested yielded very large amounts of hydrocyanic acid but the acid diminished rapidly as soon as the plants began to wilt and when they were dry it had disappeared. Although Sudan Grass giving a high content of hydrocyanic acid when tested was harmless under some conditions, under different conditions it proved harmful, but the immunity from harmful effects was not due to the animals becoming accustomed to feeding on Sudan Grass.

The toxicity of Sudan Grass has been investigated in various countries, especially in the United States, South Africa, and Australia. Full reports of these investigations have been published in the Agricultural, Veterinary, and Scientific Journals of the countries concerned. These should be referred to for fuller information on this important subject, as the investigators have not always obtained the same results, and there are still many factors which require further consideration and experimental investigation.

England. Cultivated in the Royal Botanic Gardens, Kew, in 1935, *Snowden*!

Turkey. Ankara (Jan. 32) *Kotte*!

Egypt. Nile banks, between Cairo and Keneh, *Schweinfurth* 1548! Cairo, *Herb. Hooker* (1867)! Upper Egypt, *Sieber*! Ismailia, *Muschler* (March, 1905)!

Vern. names: Garawa, Hashish el Sudan.

ANGLO-EGYPTIAN SUDAN. Grown at Arlington Farm, Virginia, from seed received from Khartoum, ex United States Sorghum Herb., *Piper*! Without precise locality, *Messrs Vilmorin* 452/1929! received Kew Sept. 1922, *Massey*! Halfa (Wadi Halfa?), in cultivations, *Meinertzhagen*!

A specimen from Kiling-Jebel Marra, 2100 m., *Steele*! is probably this species, but the spikelets are unusually hairy.

FRENCH SUDAN. El Oualadji, in irrigation channels, apparently spontaneous, but perhaps introduced for forage, *Chevalier* 43,917!

SOUTHERN RHODESIA. Victoria Falls, ex *U.S. Dep. Agric. Sorghum Herb. S.P.I.* 49,209! Without precise locality, ex *Dep. Agric. Herb.* 3034!

SOUTH AFRICA. Bloomfontein, introduced from North Central Africa, *Potts* 2897!

JAVA. Without precise locality, *Posthumus* 92!

AUSTRALIA. Queensland: Brisbane Botanic Gardens, *White* 11! Darling Downs, Inglewood—Milmarran, *White* 9736! Darling Downs, between Dulacca and Palardo, 305 m., *Blake* 7579! Redcliffe, near Brisbane, *Hubbard* 5535! Mileo, *Hubbard & Winders* 6404! Waterford, Moreton district, *Mead* 3! State Farm, Bungewogorai, *Soutter*! Barcaldine, *Stibbards*! Mitchell district, Terrick Terrick station, *Cameron*!

Two of the three sheets of *Hubbard* 5535, from Redcliffe near Brisbane, appear to have been cross-fertilized, one approaching forms of *Sorghum dochna*, and the other having the sessile spikelets only 5·5 mm. long. A specimen from the State Farm, Bungewogorai, *Soutter*, with broad leaves and short wide spikelets, may also be a hybrid between *S. dochna* and *S. sudanense*.

UNITED STATES. California: Shasta country, at Anderson, 130 m., in ditches along S.P. Railway, ex Herb. Univ. California, *Long* 79*a*!

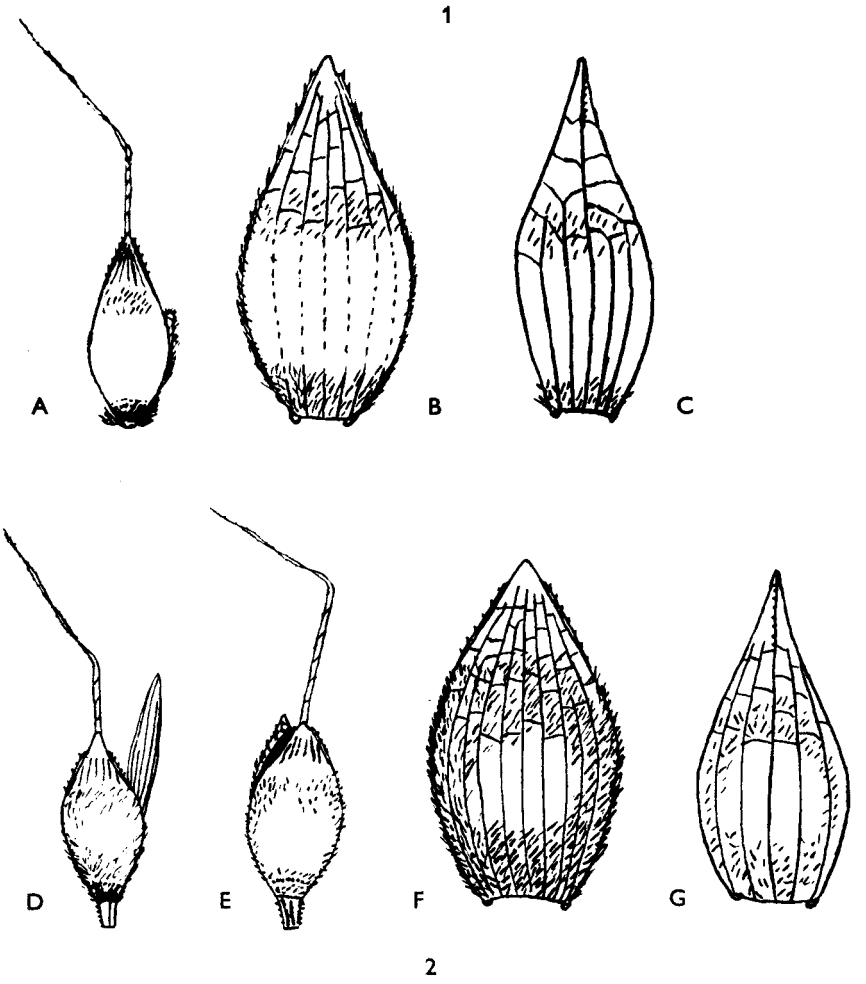
20. **Sorghum elliotii** Stapf

Sorghum elliotii Stapf in Prain, *Fl. Trop. Afr.* **9**, 118, 1917, is founded on a specimen in Kew Herbarium, *Scott Elliot* 7612, collected in the Toro district of Uganda, near the Ruwenzori Mountains.

DESCRIPTION

An annual or may persist as a short-lived perennial, but basal portion not known. *Culms* slender, up to 1 m. or more high, branched above. *Leaves* small; blades 10–30 cm. long, 8–12 mm. wide, linear, somewhat narrowed towards the base, attenuated upwards and terminating in a narrow pointed apex, dull green, with the somewhat slender mid rib rather prominent below and the margins rough. *Panicle* narrow, sublinear, about 18 cm. long and 2 cm. wide; branches 1–3 from a node, slender, the longer ascending, arching over, subsecund, up to 4 cm. long, bare of spikelets for 1–2·5 cm. from the more or less hairy base, very rough to spinulously ciliate upwards like the branchlets and the rhachis. *Racemes* tough, very tardily disarticulating, few-noded, up to 1·5 cm. long; internodes slender, about 3 mm. long, ciliate with pale fulvous hairs about 1 mm. long; pedicels similar but rather more slender and darker coloured. *Sessile spikelets* ovate to ovate-lanceolate, acute to acuminate, 4·5–5·5 mm. long, 2–2·5 mm. wide, with 4–5 nerves visible between the keels of the lower glume, straw yellow to buff, mahogany red or reddish purple, sparsely strigillose and at length glabrous and shining on the backs of the glumes, awned; callus copiously bearded with fulvous hairs about 1 mm. long. *Glumes* coriaceous but thinner near the tips; lower somewhat rounded in the lower half, 9- to 11-nerved, cross-nerves obscure, keeled from about the middle, with the fine linear margins spinulously ciliolate and merging into the hyaline tip without, or with only obscure, teeth; upper narrowly convex, keeled above the middle and scabrid near the tip, 7-nerved, with fine cross-nerves in the upper half. *Lemmas* finely long-ciliate; lower

ovate-elliptic to elliptic-oblong, 4–4·5 mm. long; upper ovate, 3–3·5 mm. long, 2-lobed from 0·5–1 mm. deep, awn 7–13 mm. long. *Anthers* 2–2·5 mm. long. *Grains* broad-elliptic to obovate-elliptic, 2–2·5 mm. long, 1·5–1·8 mm. wide, embryo-mark more or less distinct. *Pedicelled spikelets* 5–6 mm. long, purplish, ♂ or neuter, at length deciduous; lower glume 8- to 9-nerved, upper 7-nerved.



(1) *Sorghum elliotii* Stapf. A, sessile spikelet and part of pedicel; B, lower glume; C, upper glume, exterior view. (From *Scott-Elliot* 7612.) (2) *S. niloticum* (Stapf ex. Piper) Snowden var. *kavirondense* Snowden; D, sessile and pedicelled spikelets, after flowering; E, sessile spikelet in fruit; F, upper glume; G, lower glume, exterior view. (From *Edwards* 3136.) A, D and E, × 5; B, C, F and G, × 10.

Diagnostic characters and affinities

The narrow leaves, 8–12 mm. wide; small narrow panicle; few-noded tough racemes; and the ovate to ovate-lanceolate, acute to acuminate sessile spikelets, 4·5–5·5 mm. long, 2–2·5 mm. wide, with awns 7–13 mm. long, are the distinctive features of this species. It is closely related to *S. verticilliflorum*, but the latter has larger panicles, fragile racemes, and longer elliptic-lanceolate sessile spikelets. *S. elliotii* is also related to *S. niloticum* and *S. castaneum*, but it differs from the former in the smaller panicles and in the shape of the

smaller sessile spikelets, as well as in having fewer nerves in the lower glume; and from the latter in its smaller panicles, tough racemes, and longer ovate to ovate-lanceolate, acute to acuminate sessile spikelets.

Distribution and utility

S. elliotii was collected in the Toro district of Uganda near the Ruwenzori Mountains, at a place recorded by Scott Elliot as Kasamaga. It seems possible, however, that this was intended for Kasagama's, for Kasagama was then the Mukama (King) of the Toro district, and he had his capital on a hill near Fort Portal, on the eastern foothills of Ruwenzori. Although this area is much visited by Europeans no further gathering of this species has been made. The tough racemes suggest that it may have originated as a result of cross-fertilization between one of the local grain Sorghums, which belong to *S. caudatum* and *S. nigricans*, and the wild *S. verticilliflorum*, which is common in the district. The basal portion of the plant is missing, and the upper portion has the appearance of a depauperate specimen that may have arisen either from a tiller-shoot or a secondary branch from the upper part of the main stem. This species does not appear to be of any special economic importance for fodder or grazing.

Uganda. Ruwenzori region, Toro district, at Kasamaga (Kasagama's, Kabarole, near Fort Portal?), on granite, *Scott Elliot*, 7612!

This specimen was referred to by Piper (in *Proc. Biol. Soc. Wash.* **28**, 42, 1915) in a note under his subspecies *Andropogon sorghum niloticus*, but I agree with Stapf that it could not be satisfactorily included in that subspecies although, as already mentioned, it is evidently related to it.

21. **Sorghum niloticum** (Stapf ex Piper) Snowden

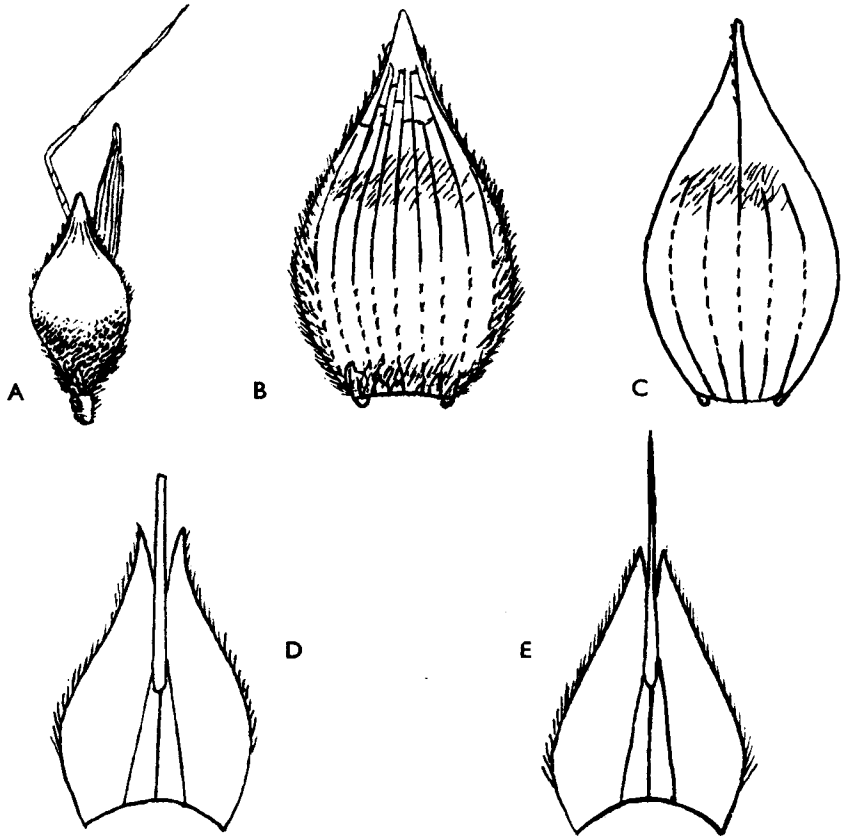
Andropogon sorghum (Linn.) Brot. subsp. *niloticus* Stapf ex Piper in *Proc. Biol. Soc. Wash.* **28**, 41, 1915, is based on a specimen in Kew Herbarium collected by Murie (on Consul Petherick's expedition) on the banks of the White Nile, a little south of Gaba Shambe, about 7° N. lat., in the Upper Nile province of the Anglo-Egyptian Sudan.

Sorghum niloticum (Stapf ex Piper) Snowden, stat.nov., is founded on Piper's subspecies *Andropogon sorghum niloticus*, raising it to specific rank on transferring it to the genus *Sorghum*.

Description

A tall annual or loosely tufted perennial about 2·5 m. high. *Culms* rather stout, 4–5 mm. wide at the base of the panicle. *Leaves* many; blades linear, somewhat narrowed towards the base, tapering gradually upwards to the acuminate tip, the uppermost 15–35 cm. long, 1–3 cm. wide, green with some purplish markings, mid rib 1–2 mm. wide and somewhat prominent below in the basal portion, margins spinulously scabrid upwards. *Panicle* loose, oblong to elliptic-oblong, 15–40 cm. long, 8–15 cm. wide; rhachis rather slender, striate and somewhat hairy below, more angular with the ridges scabrid in the upper part; branches one to few from each node, slender and flexuous, soon spreading, the lower 7–15 cm. long, usually naked below for 2–6 cm., more or less hairy at the base and in the angles of the divisions, scabrid upwards like the branchlets. *Racemes* tough, 2- to 6-noded, 0·8–2·5 cm. long, internodes and pedicels slender to rather slender, 1·5–3 mm. long, densely ciliate with fulvous or tawny to ferruginous hairs about 1 mm. long. *Sessile spikelets* elliptic-ovate to elliptic-rotund, acute to acuminate with the tips closed, or subacute with the tips slightly open, 4·5–6 mm. long, 2–3 mm. wide, straw yellow to deep cream or tawny with 5–6 greenish nerves visible between the keels of the lower glume when young, at length often mahogany red to maroon, chocolate brown or almost black, sparsely strigose at the base, sides, and just above the middle, otherwise glabrous and shining, awned or with a short bristle; callus densely bearded

when young, sparsely at maturity. *Glumes* firmly coriaceous but with rather thinner tips; lower slightly rounded on the back, 11- to 13-nerved, finely 2-keeled in the upper third, scarcely or obscurely margined, usually with the keels merging gently into the hyaline tip but sometimes ending in minute teeth; upper narrowly convex, usually 7-nerved, scabrid on the sharp keel in the upper fourth. *Lemmas* thinly to moderately ciliate; lower elliptic-ovate, 3–4·5 mm. long, 2-nerved, or rarely 3-nerved and then acuminate to mucronate; upper ovate, 3–4 mm. long, 1- to 3-nerved, 2-lobed to a depth of



Sorghum niloticum (Stapf ex Piper) var. *niloticum*. A, sessile and pedicelled spikelets; B, lower glume; C, upper glume, exterior view; D, upper lemma of awned spikelet, with basal part of awn; E, upper lemma with bristle. (All from *Murie*, banks of the White Nile.) A, × 5; B–E, × 10.

0·5–1 mm. and with an awn 8–12 mm. long, or sometimes with a bristle 2–5 mm. long. *Anthers* 2·5–3 mm. long. *Grains* obovate-elliptic to obovate, 3–4 mm. long, 1·5–2·5 mm. wide, dark brown; embryo-mark distinct. *Pedicelled spikelets* at length deciduous, 3·5–6 mm. long, mostly neuter, often purplish; lower glume 8- to 11-nerved, upper 5- to 7-nerved; anthers 0 or up to 2·8 mm. long.

Diagnostic characters and affinities

S. niloticum is distinguished by the long narrow leaves; moderately large but narrow loose panicle; tough racemes; and the elliptic-ovate to elliptic-rotund, acute to acuminate and closed, or sometimes subacute and slightly open, sessile spikelets 4·5–6 mm. long, and 2–3 mm. wide. It differs from the related *S. elliotii* in the larger panicles and the broader elliptic-ovate to elliptic-rotund sessile spikelets, as well as in having larger grains

when mature. It is also related to *S. castaneum* and *S. verticilliflorum*, but it may be separated from both by the tough racemes as well as from the former by the larger sessile spikelets and from the latter by the broader elliptic-ovate to elliptic-rotund sessile spikelets.

Distribution and utility

Up to the present this species has been recorded from the Upper Nile and Mongalla provinces of the Anglo-Egyptian Sudan, the Chua district of northern Uganda, the Kavirondo province of western Kenya, and the eastern part of the Belgian Congo. It has the appearance of being equal to *S. verticilliflorum* as a fodder crop, with the additional advantage of having larger grains and tougher racemes, which latter should facilitate the harvesting of the seed. It does not appear to have been much used for feeding stock, however, although the variety *kavirondense*, described below, is now under trial as a fodder crop in Kenya Colony. Most of the specimens enumerated below have been found on grasslands following after cultivated lands have been abandoned and allowed to become overgrown.

(i) Var. **niloticum**

Var. **niloticum**, based on *Sorghum niloticum* (Stapf ex Piper) Snowden.

Sessile spikelets elliptic-rotund, acute to acuminate, 5–6 mm. long, 2–3 mm. wide, awned or sometimes with a short bristle; grains 3–4 mm. long, 1·5–2 mm. wide, completely hidden and enclosed by the glumes when mature.

This variety is based on the specimen collected by Murie in the Anglo-Egyptian Sudan, which is also the type of the species.

Belgian Congo. Bokola, *Vanderyst* 1540!

Anglo-Egyptian Sudan. Upper Nile Province, on the banks of the White Nile, south of Gaba Shambe, *Murie*! Mongalla province, Nimule and Rejaf, *Shantz* 897! 945! *Shantz* 898! Also from Nimule, Mongalla province, is somewhat intermediate between this variety and *Sorghum castaneum*.

(ii) Var. **kavirondense** Snowden

Var. **kavirondense** Snowden, var.nov.; Spiculae sessiles elliptico-ovatae, acutae vel subacutae, 4·5–5·5 mm. longae, 2–2·5 mm. latae, aristatae; caryopsides 3–3·5 mm. longae, 2–2·5 mm. latae, inter glumas inclusae vel maturae inter glumas arcte appressas leviter apertae.

Sessile spikelets elliptic-ovate, acute or subacute, 4·5–5·5 mm. long, 2·5–3 mm. wide, awned; grains 3–3·5 mm. long, 2–2·5 mm. wide, enclosed by the glumes or when mature slightly exposed between their closely appressed tips.

This variety is founded on a specimen collected in the Kavirondo province of western Kenya, *Edwards* 3136, which is in Kew Herbarium.

Uganda. Chua district, ex *U.S. Dep. Agric. Sorghum Herb. F.C.I.* 8681!

These two specimens have leaves 5–6 cm. wide, which may be due to cultural conditions.

Kenya Colony. Kavirondo province, near Maseno, *Edwards* 3136!

Stapf (in Prain, *Fl. Trop. Afr.* 9, 118, 1917) referred to Murie's specimen in a note under *S. verticilliflorum*. He expressed the opinion that it was probably a state of the latter species with the sessile spikelets bulging more than usual and with rather tardily disarticulating racemes. The shape of the sessile spikelets, however, which are wide in proportion to their length, differs from that of *S. verticilliflorum*, and the grains are usually larger and wider than those of that species. After examining the additional material received at Kew since Stapf's account of the African Sorghums was published, I have come to the conclusion that Murie's specimen belongs to a separate species related to, but much less common than, *S. verticilliflorum*, at present restricted to a limited area near the White Nile and the adjacent African Lakes Region.