



# *Arundinella* (Gramineae) in Malesia with notes on other taxa and on aluminium accumulation

J.F. Veldkamp<sup>1</sup>

## Key words

aluminium accumulation  
*Arundinella*  
Gramineae

**Abstract** *Arundinella* Raddi (Gramineae) is revised for Malesia. There are seven species. A survey of the complicated taxonomic and nomenclatural history of the genus is given. A new species for Taiwan is described and notes are provided on sundry other ones. There is a key to the Malesian and some non-Malesian species. Some species are aluminium accumulators.

**Published on** 6 March 2015

## HISTORY

The genus *Arundinella* Raddi (Gramineae) is a pan(sub)tropical genus with c. 50 species of which seven occur in Malesia.

The first two species were described by Thunberg (1784a, b): *Agrostis ciliata* Thunb. and *Poa hirta* Thunb. Both are from Japan and belong to *A. hirta* (Thunb.) Tanaka.

Clearly, for a long time authors were at a loss about its taxonomic position. *Arundinella* species have been identified with at least *Acratherum*, *Agrostis* L., *Aira* L., *Andropogon* L., *Anemagrostis* Trin. (≡ *Apera* L.), *Arundinaria* Michx., *Brandtia* Kunth, *Danthonia* DC., *Festuca* L., *Garnotia* Brongn. (incl. *Berghausia* Endl., *Miquelia* Arn. & Nees), *Goldbachia* Trin. (≡ *Calamochloë* Rchb.), *Ischaemum* L., *Muhlenbergia* Schreb. (incl. *Trichochloa* P.Beauv.), *Orthopogon* R.Br. (= *Oplismenus* P.Beauv.), *Panicum* L., *Paspalum* L., *Piptatherum* P.Beauv., *Poa* L., *Thysanachne* C.Presl, *Trisetum* Pers., and possibly others, presently members of a wide array of subfamilies and tribes.

Willdenow (1806: 908) described *Andropogon hispidus* Humb. & Bonpl. from Cumana (Venezuela), now *Ar. hispida*. Kunth (1822) called it with some doubt *Ischaemum hispidum* (Willd.) Kunth, where reference is made to a 'l. p. 194', presumably an error for Kunth (1816: 165).

Trinius (Jan. 1821) was the first to distinguish it as a distinct genus, *Goldbachia*, followed by an assortment of species of *Panicum* L. The only species was *G. mikanii* Trin. from Brazil (= *A. mikanii* (Trin.) Nees = *A. brasiliensis* Raddi), which is an earlier homonym of *Goldbachia* DC. (20 Apr. 1821a, late May 1821b) (*Cruciferae*), but because the latter name was better known it has been conserved. The genera were named after Karl Ludwig Goldbach (1793–1824), student of *Crocus* L. and medicinal plants in Russia (Backer 1936: 238). Trinius apparently corrected his *G. mikanii* to *Riedelia mikanii* Trin. in letters to Nees (1829: 465) and Kunth (1833: 515). Nees cited it under *A. mikanii*, a superfluous name, as he also cited *Ischaemum hispidum* (Willd.) Kunth (1816: 165), now *A. hispida* (Humb. & Bonpl. ex Willd.) Kuntze. However, in 1826 (p. 62) Trinius already had reduced it to *Ar. brasiliensis*. Erroneously so, as he also cited the older *Andropogon hispidus* Willd., which epithet he should have used. Here he described four species between the panicoids *Melinis* P.Beauv. and *Pennisetum* Rich.

Raddi (1823) proposed *Arundinella*, based on *A. brasiliensis* Raddi (= *A. hispida*), a S American species, but a name much applied to Old World taxa, in Malesia for instance to *A. filiformis* Janowski and *A. goeringii* Steud.

Schultes (Jan.–Apr. 1824: 209) described *Trichochloa berteroniana* from Santo Domingo. The generic name is a synonym of *Muhlenbergia*, the species is now *A. berteroniana* (Schult.) Hitchc. & Chase (1917: 290, Janowski & Mez 1921: 85, isonym). Synonyms are *Muhlenbergia berteroniana* (Schult.) Kunth (1830: 209), *Ischaemum peruvianum* (J.Presl) Kunth (1834: xli), and *Thysanachne peruviana* J.Presl (in Presl 1830: 253).

Sprengel (late 1824: 278, 287) added some additional confusion by transferring Raddi's *Arundinella brasiliensis* to *Aira brasiliensis* (non *Aira brasiliensis* Raddi 1823 = *Sporobolus brasiliensis* (Raddi) Hack.) and described a new one as *Andropogon virens*, respectively. Both are synonyms of *Ar. hispida*.

Link (1827) created *Acratherum* based on *Ac. miliaceum* Link (= *Ar. nepalensis* Trin.) from Nepal. *Acratherum* is 'ἄκρος, apical, ἄθηρ, awn: the awned upper lemma (Backer 1936: 5). He included this in an ambiguously defined 'subordo' (= ? tribe) *Tristegineae*. See note below.

Reichenbach (1828) also was aware of the homonymy of *Goldbachia*, but not of the exact dates and he proposed *Calamochloë* without specific combinations (καλαμος, reed, χλοή, grass). He included it in the *Saccharineae* – *Triandrae*, which contained many andropogonoid genera. Not so bad an idea, as it has turned out.

Nees (< 21 Mar. 1829) regarded *Arundinella* as close to *Gynerium* P.Beauv. of the 'Arundinaceae'.

*Thysanachne* C. Presl (30 May 1829) was based on *T. scoparia* from Martinique, which is a synonym of *A. hispida*. *Thysanachne* (θυσσανός, brush, ἄχνη, chaff) refers to the hairy glumes (Backer 1936: 585). It was included in the 'Bromaceae'.

*Agrostis ciliata* was renamed to *Festuca ? thunbergii* by Kunth (Oct. 1829: 133), a name change required because of the earlier use of *Ag. ciliata* by Goüan (1762: 48, 547). The later description by Kunth (1833: 412) was based on a Burman specimen (now in G?) and mentioned 3-flowered spikelets, suggesting that it could not have been an *Arundinella*.

*Brandtia* Kunth (1831) was based on *B. holcooides* Kunth (= *A. holcooides* (Kunth) Trin.) from Pegu, Burma, and honoured

<sup>1</sup> Naturalis Biodiversity Center, section Botany, P.O. Box 9517, 2300 RA Leiden, The Netherlands; jef.veldkamp@naturalis.nl.

Johann Friedrich (von) Brandt (1802–1879), co-author of a work on German poisonous plants. Kunth regarded *Brandtia* as close to *Eriachne* R.Br. and in 1833 as part of the 'Avenaceae' between *Danthonia* DC. and *Eriachne*. He expressed doubt, however, whether it belonged to this 'section'. In 1833 he had *Goldbachia* as a synonym of *Ischaemum hispidum* of the *Andropogoneae*.

Steudel (1854a: 114–116) using a manuscript by Nees enumerated 30 spp. of *Arundinella* and one of *Brandtia* in the *Paniceae*. Pfeiffer (1870) included *Arundinella* and *Brandtia* in the *Paniceae*.

Debeaux's *Chalynochlamis* Franch. (1879) was a *nomen nudum*. Keng (May 1936: 12) reduced it to *Arundinella* subg. *Chalynochlamis*, but this is invalid as there was no Latin description. The only species cited is *Ch. anomala* Franch., in synonymy under *A. anomala* Steud. (= *A. hirta*). The derivation was not explained, possibly it is from χαλινός, bridle or bit, and χλαμύς, mantle, but this allusion I do not understand. Debeaux also cited as a synonym *Paspalum mandshuricum* Maxim. which is a new (invalid) combination, perhaps a slip of the pen for *Panicum mandshuricum* Maxim. (1859: 328) ('une excellente description').

Bentham (1881: 85) included the genus in the *Tristegineae* and regarded Nees's 'sections' as 'not well defined'. He repeated this in 1883.

Hackel (1887, 1896) gave a better circumscription of the *Tristegineae*, but still included genera that we now consider to belong to several other (sub)tribes. This was more or less followed by Bentham (1883).

Stapf (1898), without any explanation, erected the tribe *Arundinelleae* with *Arundinella*, *Trichopteryx* Nees, and *Tristachya* Nees, next to the *Aveneae* Dumort. in the *Pooideae* and this tribe has been generally accepted since, but with varying contents and position.

Janowski & Mez (1921) gave no indication that Stapf had done so and created the *Arundinelleae* again. Mez is cited as the author by Janowski (1922: 21). She recognised 50 species and five uncertain ones worldwide. According to Mez's manuscript of the *Paniceae* in B for the Pflanzenreich (photocopy in L) he did not consider it to belong there.

The problem with Janowski's treatment is that she based it mainly on material available in Königsberg (now Kaliningrad, KLGU, destroyed), B (destroyed, Dr. H. Scholz, in litt.) and only a few specimens in M that I have seen.

Hubbard (1936: 317) noted that the *Tristegineae* "should not include *Arundinelleae* and its allies. The latter form a very natural group which may be distinguished from *Melinis* related genera, etc."

Keng (1936) in a very important revision for Asia described 32+ species in the *Panicoidae*.

Herter (1940: 136) proposed the *Arundinellaceae* (Stapf) Herter and *Tristeginaceae* (Link) Herter. These are not alternative names as they have different types (*Arundinella*, *Tristegis* Nees, respectively) but are not validly published under Art. 34.2. It may be argued that according to the ICN (McNeill et al. 2012) Art. 34.1(a) and perhaps (c) apply as it would seem that he did not accept his own *Tristeginaceae* referring it ('v.' for 'vide', 'see', and not 'vel', 'or') to the *Arundinellaceae*.

Pilger (1954: 326) included the *Arundinelleae* in the *Festucoidae* between the *Arundineae* Rchb. and *Thysanolaeneae* C.E.Hubb.

This position seems to have been accepted by Bor (1955: 378, 1960: 417). In 1955 the *Arundinelleae* are in the *Pooideae* (the correct name for the *Festucoidae*), but because in 1960 the sequence of the tribes is alphabetical, no further affinity can

be deduced. He here revised the 23 species of India, Burma, and Sri Lanka and this is the most recent important work for that area. It was more or less extracted and copied by Moulik for India (1997: 54–62), who had 21 species.

Bor did mention Keng's publication, but did not comment on his classification, nor provided one of his own.

Conert (1957) in a purported world revision saw material from B and K, apparently very little judging from the specimens he cited, and he had only 23 species, not because he reduced so many of the ones that Bor (1955) had recognised for India (also 23, but not the same ones!). Remarkably, he did not refer to Janowski (1922), nor to Keng (1936).

Phipps started a revision of the *Arundinelleae* (1964–1972, see also Li et al. 1966, Correia et al. 1967, Li & Phipps 1973 Lubke & Phipps 1973), but unfortunately had to direct his attentions elsewhere. He (1966b: 241–244) gave a survey based in literature with 48+ species, and an infrageneric classification (1967a) with 47.

Clayton & Renvoize's (1986; repeated in Clayton 1989) comments on the *Arundinelleae* are noteworthy: "The tribe suffers from an overabundance of potentially significant generic characters which occur in a bewildering number of different combinations. Consequently there is considerable disagreement over generic limits, and a variety of alternative treatments may be found."

Of importance to the Malesian region is also the account of the four species in Australia by Simon (1983). Two are endemics of Queensland, *A. grevillensis* B.K.Simon (1983) and *A. montana* S.T.Blake (1941), and one is *A. nepalensis* Trin., which would then be one of very few species that have 'jumped over' Malesia. Ominous is his remark: "All three species are almost identical in their spikelet morphology, and differ only by vegetative characters." The fourth species is *A. setosa* Trin., also found in West Australia and the Northern Territory.

For Thailand Nanakorn & Norsangsri (2001) enumerated 9 species; *A. kokutensis* Teerawat. & Sungkaew (in Teerawatanon et al. 2010) and *A. kerrii* Teerawat. & Sungkaew (in Teerawatanon et al. 2011) have been added since.

Sun & Phillips (2006) gave an account of the 20 species of China and Taiwan.

Recent chemical / molecular research has been summarised by Teerawatanon et al. (2011). They concluded that *Arundinella* was best regarded as the sole genus of the subtribe *Arundinellinae* (Stapf) Honda, sister to or basal in the *Andropogoneae* Dumort.

### **The nomenclatural status of *Tristegineae***

Link (1827: 230) described the 'subordo' (= ? tribe) *Tristegineae* ('*Tristeginae*'). Nees (1837: 237) is usually cited as the author of the tribe, but he did attribute the name to Link and it is merely a literature reference and not a *nomen nudum* as is often stated. The name has been widely used in agrostological literature of the 19th to the mid 20th centuries, if it was not rejected because *Tristegis* (Nees 1820: 47, 54) was included in the *Paniceae* R.Br. (1814: 582). Yet, all suprageneric names derived from *Tristegis* Nees are illegitimate, as this is a superfluous name for *Suardia* Schrank (1820: t. 58) (Art. 19.5). This is considered to be a synonym of *Melinis*, and so, taxonomically, the correct tribal place for it is in the *Melinideae* Hitchc. (1920: 18). This seems to have been noted only by Clayton & Renvoize (1986: 295) and Sorong & Pennington (2003: 628).

Bor (1955: 378) regarded Link's circumscription of the tribe as "sufficiently nebulous as to embrace genera which did not easily fall into tribes or groups already described". But this is a taxonomic complaint, the type method makes the application clear.

Clayton (1981) proposed to reject all suprageneric names published by Link as they would be “wholly interpretable as to the category intended”. An example is the attribution by Sorong & Pennington (2003: 628) of the tribe *Tristegineae* to Bentham (1883: 1075, 1080, 1118) and the subfamily *Tristeginoideae* to Link.

Harvey (1868: 428) described the subtribe *Tristegininae* (*Tristegineae*) in the *Panicaceae*.

The *Tristeginaceae* Herter has been mentioned above.

### Infrageneric classification

Nees (1837) without any elucidation recognised two subgenera: subg. *Acratherum* (Link) Nees (for *Ar. glabra* Nees), a species without setae lateral to the awn, typified by *Ac. miliaceum* Link (= *Ar. nepalensis*), and subg. *Miliosaccharum* Nees (with *Ar. nervosa* (Roxb.) Nees) for species with them.

Bentham (1881, 1883) commented that these were “not well defined”.

Janowski (1922) did not give any infrageneric classification.

Keng (May 1936) in a study of Asian species recognised 4 subgenera. Their diagnostic characters were given in a key:

1. Subg. *Psilachne* Keng. Fertile lemma awnless, the callus entirely glabrous. — Validated on p. 7. — Type: *A. thwaitesii* Hook.f.
2. Subg. *Chalynochlamis* (Franch. ex Debeaux) Keng. Awn of fertile lemma absent or minute, callus hairs 0.33–0.67 times as long as the lemma. — Described on p. 12, but the basionym originally was mentioned in synonymy, and here there is no Latin diagnosis as is required after 1 Jan. 1935, hence it is invalidly published. — Voucher: *A. anomala* (= *A. hirta*).
3. Subg. *Arundinella*. Awn of fertile lemma present, geniculate, if absent, callus hairs less than 0.25 times as long as the lemma, without lateral setae (sometimes present in *A. hookeri* Munro ex Keng). — Further description absent. — Type: *Arundinella brasiliensis* was not treated by Keng as it is an American species. *Arundinella glabra*, the type of subg. *Acratherum*, is cited under *A. nepalensis*, but the autonym has precedence.
4. Subg. *Miliosaccharum* Nees. Awn of fertile lemma with 2 lateral setae. — Further description absent. On p. 59 Keng comments on the presence and absence of these setae in *A. setosa* and wonders about the taxonomic value of this character. — Type: *A. nervosa* Nees.

Conert (1957: 332) remarked “A subdivision of the genus in sections according to the characters of the lemmas of the upper flower (awn and lateral lobes) can equally not be realised.”

Phipps (1967a) distinguished 15 series and observed that none is very distinct from the one most similar to it. He judged that Keng’s subgenera were based on too few characters, yet that they were useful for main divisions in a key. Although subgeneric epithets were available, he used new ones, which, as they are on the series level, is permissible. Only ser. *Nepalenses* J.B.Phipps must be rejected, as the autonym *Arundinella* is required here.

It is of course beyond the limited scope of this paper to comment pro or contra an infrageneric classification.

### Variability

Bor (1955: 406) exclaimed “the variation exhibited by this species is so fantastic that one would, in despair, give up hope of dealing with it in a rational matter”, and elsewhere (p. 409) “as with most species of *Arundinella* the search for stable characters, whereby some of the forms could be separated as good varieties, has been in vain.”

Conert (1957: 331) observed “The species of *Arundinella* are – with few exceptions – difficult to delimitate against one another. The morphology of the spikelets is identical in many species and the other characters ... are very variable”.

Phipps (1966b: 240–241) wrote “The complex of *A. hispida*–*A. nepalensis* and allies is in a state of serious taxonomic confusion. At the level of spikelet morphology, at least, *Arundinella* is a genus with little diversity. The taxonomy is weakest for South-East Asia.”

Simon (1983: 463–464) in a similar vein remarked about the species of Australia “All three [of the four, incl. *A. setosa*] species are almost identical in their spikelet morphology, and differ only by vegetative characters.”

These cries of despair, frustration, impotence, and irritation came to mind during the present study. When in the beginning I was dealing with forms of what I initially called the *A. holcooides* group it appeared that there were a number of local populations more or less quite distinct and differed from each other sufficiently to be called ‘species’. However, when studying the Burmese *A. birmanica* and *A. holcooides* which Bor (1955: 385, 1960: 421) had kept separate, but apparently with some doubt, even with the few specimens available these two turned out to be indistinguishable, as he already had predicted (1955: 413). When the resulting description was analysed with DELTA another ‘species’, now from Celebes, showed no significant differences, only some extension of ranges in variability of some parts, and when that one was added, one after another fell into a veritable botanical black hole, whereby in this treatment *A. holcooides* is regarded as a species with a disjunct distribution in W Bengal and C and S Burma, then in S Vietnam, and in Malesia in the Philippines (Luzon, Mindoro, Palawan) and SW Celebes.

The only one that remained unscathed is the new *A. taiwanica* Veldk.

### ALUMINIUM ACCUMULATION

by B.J. van Heuven & J.F. Veldkamp

Aluminium accumulators are apparently very exceptional in grasses. Yoshii & Jimbo (1932) tested 31 species, mentioning only *Miscanthus sinensis* Andersson by name. Chenery (1949) sampled 15 and Webb (1954) 16 from New Guinea and Australia. Unfortunately, because they had no positive results they all omitted to mention which species had been studied. A rather recent general survey of Al-accumulation is by Metali et al. (2012).

The first positive report for a grass was by Chenery in Bor (1955: 414) for *A. fuscata* Nees ex Buse (as *A. purpurea* Hochst.). A few other species have become known since, e.g. *Paspalum notatum* Flügge (Huang et al. 2009), *Sporobolus indicus* (L.) R.Br. var. *capensis* Engl. (as *S. africanus* (Poir.) Robyns & Tournay) (Anonymous on the internet). *Chrysopogon zizanioides* (L.) Roberty (Luque et al. 2006) apparently takes up Al relative to the amount present in the substrate. On the internet a *Setaria* species is mentioned, but we failed to find out which one.

Curiously, Chenery noted that *A. fuscata* auct. (? = *A. goeringii*), which Bor cited as a synonym, is not an accumulator. This is another example of the confusion around the application of *A. fuscata*.

We tested a number of *Arundinella* specimens for accumulation of aluminium using the procedure of Chenery (1948). Specimens and results are listed in Table 1. The degree of discolouration was assessed by several people independently. Discolouration occurred in nearly all samples and may be due to the extraction of other substances. Only a few samples were decidedly positive (++ in Table 1).



**Table 1** Reaction with Aluminon (– no visible reaction; + slight reddish discolouration, ++ strong red discolouration). Taxonomic groups according to Keng (1936) and Phipps (1967a). All vouchers from L.

Specimen	Discolouration	Taxonomic groups
<i>A. filiformis</i> (BS 19286)	–	<i>Arundinella</i> s.str.
<i>A. furva</i> (Marsden et al. 165)	++	<i>Arundinella</i> s.str.
<i>A. fuscata</i> (Perrotet 1231)	++	<i>Arundinella</i> s.str.
<i>A. goeringii</i> (Backer 10546)	+	<i>Arundinella</i> s.str.
<i>A. grandiflora</i> (Delevay s.n.)	–	<i>Arundinella</i> s.str.
<i>A. grevillensis</i> (Telford 3240)	+	<i>Arundinella</i> s.str.
<i>A. nepalensis</i> (Thakur Rup Chand 8136)	–	<i>Arundinella</i> s.str.
<i>A. bengalensis</i> (Wallich 8669-B)	+	<i>Arundinella</i> / <i>Bengalenses</i>
<i>A. holcooides</i> (Veldkamp 8913)	+	<i>Arundinella</i> / <i>Ciliatae</i>
<i>A. laxiflora</i> (Kostermans 27559)	+	<i>Arundinella</i> / <i>Laxiflorae</i>
<i>A. leptochloa</i> (McCann Mar. 1919)	++	<i>Psilachne</i> = <i>Leptochloae</i>
<i>A. thwaitesii</i> (Davidse & Sumithraarachchi 8597)	++	<i>Psilachne</i> = <i>Leptochloae</i>
<i>A. pumila</i> (Veldkamp 8927)	++	<i>Arundinella</i> / <i>Pumilae</i>
<i>A. setosa</i> (Backer 25099)	+	<i>Arundinella</i> / <i>Setosae</i>

There is no obvious correlation between aluminium accumulation and the taxonomic groups distinguished by Keng (1936) and Phipps (1967a). Obviously, because the sample is so small while it is unknown how variable Al-accumulation is, this is only a pilot project inviting more extensive study both in *Arundinella* as well as in other grasses. Causes for variable results may be due to climate, season, soil, genetic inclination, part of the plant sampled, etc.: some species are active accumulators (e.g. *Symplocos* spp., *Symplocaceae*, or *Xanthophyllum* spp., *Polygalaceae*), but others may be passive, e.g. *Chrysopogon zizanioides*.

#### ARUNDINELLA Raddi, *nom. cons.*

*Arundinella* Raddi (1823) 63, t. 1, f. 3; Janowski (1922) 21; Keng (1936) 1; Bor (1955) 377; Phipps (1966b) 235; 1047 [incl. ser. *Nepalenses* J.B.Phipps: 1048, nom inval.]. — Type: *Arundinella brasiliensis* Raddi (= *Arundinella hispida* (Humb. & Bonpl. ex Willd.) Kuntze).

*Goldbachia* Trin. (Jan. 1821) 81, nom. rej., non DC. (20 Apr. 1821, nom. cons., *Cruciferae*). — *Calamochloë* Rchb. (Dec. 1828–Mar. 1829) 52, nom. superfl. — Type: *Goldbachia mikanii* Trin. (= *Arundinella hispida* (Humb. & Bonpl. ex Willd.) Kuntze).

*Acratherum* Link (1827) 230. — *Arundinella* Raddi subg. *Acratherum* Nees (1837) 237. — Type: *Acratherum miliaceum* Link (= *Arundinella nepalensis* Trin.).

*Brandtia* Kunth (1831) 511, t. 170. — Type: *Brandtia holcooides* Kunth (= *Arundinella holcooides* (Kunth) Trin.).

*Arundinella* Raddi ser. *Ciliatae* Phipps (1967a) 1049. — Type: *Arundinella ciliata* (Roxb.) Nees ex Miq.

*Arundinella* Raddi ser. *Pumilae* Phipps (1967a) 1050. — Type: *Arundinella pumila* (Hochst. ex A.Rich.) Steud.

*Arundinella* Raddi ser. *Setosae* Phipps (1967a) 1051. — Type: *Arundinella setosa* Trin.

Annuals or perennials. *Culms* hollow. *Ligule* a membranous truncate collar, margin ciliolate to glabrescent. *Blades* linear-lanceolate to linear. *Inflorescence* paniculate. *Pedicels* distinctly unequal. *Spikelets* quaquaversal, paired, laterally compressed, 2-flowered, lower floret sterile, male, female, or bisexual, upper floret (usually bisexual) dehiscent. *Glumes* unequal, longer and thinner than the upper lemma; lower glume 1–5-nerved; upper glume as long as the spikelet, 1–7-nerved. *Rachilla* process absent. First lemma 1–7-nerved, similar to the upper glume, epaleate or paleate, sterile, male, female, bisexual; second lemma indurated at maturity, deciduous, callus glabrous or puberulous, apex entire or 2-dentate, awned from the acumen or sinus, smooth to scaberulous or papillose, very inconspicuously 3-nerved. *Anthers* 3, rarely 2. *Styles* 2. *Hilum* punctiform; embryo 0.33–0.5 times as long as the caryopsis.  $\times = 6, 7, 8, 9, 10, 12, 17, 27$ .

Distribution — Pan(sub)tropical, c. 50 spp., 7 in Malesia; remarkably, it has only been seen once (*A. goeringii*) from Borneo and never from the Moluccas.

#### KEY TO THE MALESIAN TAXA

- Blade margins smooth, scaberulous, stiffly ciliate, or pilose. Panicle branches smooth, scaberulous or puberulous. Pedicels smooth, scaberulous, puberulous, or sparsely pilose. Lower glume distinctly shorter to slightly longer than the lower lemma. Upper lemma apex without lateral setae . . . 2
- Blade margins scabrous. Panicle branches scabrous. Pedicels scabrous, apically setose. Lower glume distinctly longer than the lower lemma. Upper lemma apex with lateral setae (when absent 'esetosa', apex of the pedicels setose). — Plants perennial. Panicle loosely contracted, branches angular. Lower lemma 3.2–4.5 mm long . . . . . 7. *A. setosa*
- Panicle densely contracted to lax, branches angular. Lower lemma 1.5–4.8 mm long . . . . . 3
- Panicle effuse, not interrupted at base, branches terete. Lower lemma 1.3–1.4 mm long. — Plants annual. Spikelets 1.5–2.2 mm long. Upper lemma callus puberulous . . . . . 6. *A. pumila*
- Upper lemma callus puberulous . . . . . 4
- Upper lemma callus bearded. — Plants perennial. Ligule ciliolate. Blades rigid, 5–13 mm wide. Glume apex acuminate. Upper lemma 2.5–3.2 mm long. Philippines (Sibuyan), New Guinea . . . . . 2. *A. furva*
- Ligule glabrous or ciliolate . . . . . 5
- Ligule pilose. — Sheaths sparsely pilose with bb hairs. Ligule pilose. Blades flaccid to rather stiff, 4.5–17 mm wide, margins pilose. Panicle fairly lax, interrupted at base. Lower lemma apex acuminate . . . . . 3. *A. goeringii*
- Plants perennial . . . . . 6
- Plants annual. — Sheaths glabrous, margins hairy or pilose with bb hairs, glabrescent. Ligule glabrous or ciliolate. Blades flaccid, margins smooth, pilose. Panicle loosely contracted to fairly lax, interrupted at base, 1–8 cm wide, branches angular. Spikelets whitish with green nerves, greenish, yellowish, or purple suffused. Lower glume slightly shorter to slightly longer than the lower lemma. Lower lemma 1.5–4 mm long, apex acute . . . . . 4. *A. holcooides*
- Blades 0.5–3 mm wide. Panicle 1–4 cm wide. — Blades rather stiff to rigid, margins smooth or scaberulous or sparsely pilose. Panicle not interrupted at base. Upper glume apex long-acuminate. Lower lemma apex acute to acuminate. Malesia . . . . . 1. *A. filiformis*
- Blades 3–18 mm wide. Panicle 5–13 cm wide. — Blades flaccid to rather stiff, margins scaberulous. Lower glume distinctly shorter than the lower lemma. Lower lemma apex acute, callus puberulous. Not yet in Malesia . . . . . 5. *A. nepalensis*

### 1. *Arundinella filiformis* Janowski

*Arundinella filiformis* Janowski (in Janowski & Mez 1921) 85; (1922) 26. — Type: *Loher 7228* (holo M; K, US).

[*Arundinella miliacea* (Link) Nees 'forma minor' Nees (1850) 102, see note. — Voucher: *Cuming 667* (CGE, K, L, US, W)].

*Arundinella hispida* (Humb. & Bonpl. ex Willd.) Kuntze forma *humilior* Hack. (1904) 527. — *Arundinella hispida* (Humb. & Bonpl. ex Willd.) Kuntze subsp. *humilior* Hack. (1906) 179; (1907a) no. 606. — *Arundinella humilior* Jansen (1953) 232 (see 233 for correction of error in basionym). — Type: *Faurie 756* (holo W; iso possibly in A, B, BM, BR, F, GH, H, TI, W. Not found in K). See note.

*Arundinella caespitosa* Janowski (in Janowski & Mez 1921) 85; (1922) 26. — Lectotype: *BS 30 (Foxworthy)* (holo W, fragm. in L; BO, K), designated here. [*Arundinella montalbanica* Elmer (1939) 3807, nom. nud. in syn. — Voucher: *Elmer 17433* (PNH†; K, L, U)].

*Arundinella agrostoides* auct. non Trin.

*Arundinella ciliata* auct. non Miq.

*Arundinella hispida* auct. non Kuntze.

*Arundinella miliacea* auct. non Nees.

*Arundinella nepalensis* auct. non Trin.

*Arundinella pubescens* auct. non Hack. & Merr.

Plants perennial. *Culms* tufted, 0.14–0.7 m long. *Nodes* glabrous to puberulous. *Sheaths* glabrous to margins hairy to sparsely pilose with bb hairs. *Throat* glabrous to hairy. *Ligule* 0.3–0.7 mm high. *Blades* rather stiff or rigid, flat or involute, linear, 3.5–16 cm by 0.5–1(–3) mm (when flattened out), glabrous, exceptionally pilose on both sides, margins smooth or scaberulous or sparsely pilose. *Peduncle* glabrous under the panicle. *Panicle* loosely contracted, exceptionally lax, not interrupted at base, 5–16 by 1–2(–4) cm, lowermost branch solitary, rarely paired, longest branch 1.5–10 cm long, angular, smooth to scaberulous or puberulous, not pilose, rarely sparsely pilose. *Pedicels* smooth to scaberulous to puberulous. *Spikelets* 3.2–5 mm long, greenish or yellowish or brownish or purple suffused. *Glumes* glabrous; lower glume 2.3–3.8 mm long, 0.55–0.84(–1) times as long as the spikelet, distinctly shorter to slightly longer than the lower lemma, apex acute to mucronate, 3- or 5-nerved; upper glume 5-nerved, apex long-acuminate. Lower lemma neuter (paleate) or male, 2.6–3.8 mm long, 3- or 5-nerved, apex acute to acuminate; upper lemma 1–2.5 mm long, castaneous in fruit, microscopically scaberulous (40×!), 0-nerved, callus hairs 0.3–0.6 mm long, 0.19–0.43 times as long as the lemma, apex acute, without lateral setae, awn distinctly exerted beyond the glumes, geniculate, 3.5–9.5 mm long when dry, column 0.4–2.5 mm long when dry. *Anthers* 3, 0.8–1.5 mm long.

Distribution — Taiwan (no locality: *Faurie 756*, W), Malesia: Lesser Sunda Isl. (Flores, Sumba), Philippines (Luzon, Palawan, Panay, Samar), New Guinea (Irian Jaya: Idenburg R.).

Habitat — On (lime)stone near or in running water, sometimes partly submerged, along forest edge, 125–780 m altitude.

Few collections are provided with details; when there is, it is often said to have been found near or even submerged in water. *Kneucker Gram. Exsicc. 606* (Merrill) (K, L, etc.) has an extensive label, where it is stated to have been found immediately above the level of high tides in the shade of *Syzygium mimumicium* (Merr.) Merr. (*Myrtaceae*), a facultative rheophyte, the rheophytic *Atalantia linearis* (Blanco) Merr. (*Rutaceae*), and *Homonoia riparia* Lour. (*Euphorbiaceae*), while other herbaceous plants were absent in the neighbourhood. The dense root system also suggests that this species is a rheophyte.

Notes — The holotype (*Faurie 756*) of *Arundinella hispida* f. *humilior* is also a syntype of *A. caespitosa*. It is the only collection from Taiwan that has come to my attention. Perhaps *Ohwi 1424* (US) not seen by me, but mentioned by Phipps (1967a: 1047) belongs here or to *A. taiwanica*.

*Arundinella caespitosa*, *A. filiformis*, and *A. hispida* subsp. *humilior* have often been regarded as synonymous with *A. miliacea*.

However, the latter combination was mentioned only by Nees (1840) and doubtfully validly made by Nees (1850) as he merely cited '*Acratherum*' which has been regarded as an indirect reference to *Acratherum miliaceum* Link. Even when accepted, the combination is not applicable to Malesian material, as it is a synonym of *A. nepalensis* which does not occur in that region.

The so-called 'forma minor Nees' is not a name, but a diagnose. Sun & Phillips (2006: 569) reduced this to *A. pubescens* Merr. & Hack.

The Sumba collection by *Monod de Froideville (1775, K, L)* is an exceptionally large specimen, both in the vegetative and the generative parts. The measurements in brackets given above refer to this one. It is distinctly perennial with sterile shoots and cataphylls. There are no ripe spikelets, so it can not be seen whether the upper florets will turn castaneous, as in the others. Without additional material this collection is best maintained as a giant *A. filiformis*. The K specimen was sampled by Teera-watananon for molecular research (Jodrell Lab. no. 22521).

### 2. *Arundinella furva* Chase

*Arundinella furva* Chase (1943) 85, t. 4. — Type: *Clemens 5826-A* (holo US; B, L, NY).

*Trisetum latifolium* Ridl. (1916) 250. — (*Arundinella latifolia* Ohwi ex Jansen (1953) 233, nom. prov., non E.Fourn. (1886)). — Lectotype: *Kloss s.n., Camp IX-X* (holo BM), designated by Veldkamp & Van der Have (1983).

*Arundinella nepalensis* Trin. var. *contracta* Ohwi (1942) 4. — Type: *Kanehira & Hatusima 13506* (holo FU; A).

*Arundinella nepalensis* auct. non Trin.

*Trisetum latifolium* auct. non Ridl.

Plants perennial (new shoots sometimes from decumbent culms). *Culms* tufted, erect to geniculate at base, 0.4–1.5 m long. *Nodes* glabrous or puberulous, rarely bearded. *Sheaths* pilose with bb hairs to margins hairy to glabrous. *Throat* hairy. *Ligule* 0.4–0.5 mm high. *Blades* rigid, flat, linear-lanceolate to linear, 3.5–24 cm by 5–13 mm, glabrous or pilose above or pilose on both sides, margins smooth or scaberulous or stiff ciliate. *Peduncle* glabrous under the panicle. *Panicle* densely contracted to fairly lax, interrupted at base or not, 7–25 by 0.8–7.5 cm, lowermost branch solitary or paired, longest one 2.5–8 cm long, branches angular, scaberulous or puberulous, not pilose. *Pedicels* scaberulous or puberulous. *Spikelets* 4.2–6 mm long, yellowish or purple (with green nerves). *Glumes* glabrous; lower glume 2.9–5 mm long, 0.6–0.82 times as long as the spikelet, distinctly shorter than the lower lemma, apex acuminate or mucronate, 3- or 5-nerved; upper glume 3- or 5-nerved, apex acuminate. Lower lemma neuter (paleate or epaleate), 3.5–4.8 mm long, 3- or 5-nerved, apex acuminate; upper lemma 2.5–3.2 mm long, castaneous in fruit, microscopically scaberulous (40×!), 0-nerved, callus hairs 0.5–0.7 mm long, 0.16–0.29 times as long as the lemma, apex acute, without lateral setae, awn distinctly exerted beyond the glumes, geniculate, 3–4.5 mm long when dry, column (0–)0.5–1.2 mm long when dry. *Anthers* 3, 1.2–1.5 mm long.

Distribution — Malesia: Philippines (Sibuyan, Mayos Peak), apparently disjunct within New Guinea as well: Irian Jaya (Arfak, Baliem, Carstensz), Papua New Guinea (Engga, W Highlands, E Highlands, S Highlands, and then Central, Northern, Milne Bay Prov.).

Habitat — Open grassland (usually fire induced), e.g. with tree ferns, *Burmanna* sp., *Cyperaceae* (e.g. *Schoenus* sp.), *Dimeria chloridiformis* (Gaudich.) K. Schum. & Lauterb., *Eriocaulon* sp., *Eulalia leptostachys* (Pilg.) Henrard, *Miscanthus floridulus* (Labill.) Warb., *Xyris* sp., landslides, marshy soil, mid montane forest, along stream edges, among limestone, granitic sand, dominant, (1500–)1850–2895(–3375) m altitude.

Collector's notes — Stolonerous (i.e. decumbent culms) or small tussocks. Culms upright to trailing, geniculate, purple.

Nodes brown, brownish purple, swollen. Leaves green, yellow green, dull mid green, tough. Peduncles purplish. Flowers brown, reddish, purplish brown, dark red, purple, later straw-coloured; awns yellowish brown, whitish red.

Uses — Not eaten by wallabies, disliked by cattle.

Notes — Although the species was described on Clemens collections from the Saruwaged, I have not seen any other collection from the Morobe Province. Remarkable is the apparent absence in some other areas, e.g. Mt Wilhelmina (Mangen 1993), Star Mts (pers. obs.), Mt Wilhelm (Johns & Stevens 1971).

Most remarkable is the single record (*Argent & Reynoso 89127* (L, PNH)) from the Mayos Peak, Sibuyan in the middle of the Philippines at c. 1550 m altitude.

Chase described the upper lemma ('fruit') as bidentate. I have only seen acute apices.

The column is sometimes virtually absent, there is only a sharp bend at the expected place.

### 3. *Arundinella goeringii* Steud.

*Arundinella goeringii* Steud. (1854a) 116. — Type: *Goering II, 139* (holo P; from Java, not Japan).

[*Arundinella hispida* Nees ex Buse var. '*β angustior*' Buse (Feb. 1854) preprint: 19; 359, not a name, but a diagnose. — Vouchers: *Junghuhn s.n. 'Tjibogo'* (L, sh. 902.23-56, 908.83-1356, 'Tjerimai' (L, sh. 908.83-1332; fragm. in K), with label by ? Nees].

*Arundinella agrostoides* Trin. var. *intermedia* Kuntze (1891) 761. — Type: Kuntze '*Java, Megamendong*' (NY not found; K).

*Arundinella procumbens* Janowski (in Janowski & Mez 1921) 84; (1922) 25. — Type: *Warburg 1648* (holo B†), perhaps in A, BM, E, K, NY. Error for 16483?

*Arundinella agrostoides* Trin. var. *ciliata* auct. non Kuntze: Kuntze (1891) 761, pro Kuntze 4805 (K, NY) from Java.

*Arundinella fuscata* auct. non Buse.

*Arundinella hispida* auct. non Kuntze.

*Arundinella nepalensis* auct. non Trin.

Plants annual or perennial. Culms tufted or more or less solitary, erect, 0.15–0.6 m long. Nodes bearded. Sheaths sparsely pilose with bb hairs. Throat hairy. Ligule 0.3–1 mm high, pilose. Blades flaccid to rather stiff, flat, linear-lanceolate to linear, 4.5–25 cm by 4.5–17 mm, pilose on both sides, margins pilose. Peduncle under the panicle glabrous. Panicle contracted, often interrupted at base, 6.5–30 by 1–6 cm, lowermost branch 1–3 together, the longest one 2–4 cm long, branches angular, smooth to scaberulous, glabrous. Pedicels smooth to scaberulous. Spikelets 4.2–6 mm long, greenish to purple suffused. Glumes glabrous; lower glume 2.4–4 mm long, 0.6–0.86 times as long as the spikelet, distinctly shorter to slightly longer than the lower lemma, apex acuminate to caudate to mucronate, 3- or 5-nerved; upper glume 5-nerved, apex long-acuminate. Lower lemma male or bisexual, 2.8–3.5 mm long, nerves 5, rarely 3, not anastomosing, apex acuminate; upper lemma 1.8–2.3 mm long, whitish to brown or castaneous (at maturity), microscopically scaberulous (40×!), 0-nerved, callus hairs 0.4–0.7 mm long, 0.2–0.37 times as long as the lemma, apex acute, without lateral setae, awn distinctly exerted beyond the glumes, geniculate, 3.3–5 mm long when dry, column 1–1.9 mm long when dry. Anthers 3, 0.8–1 mm long.

Distribution — Malesia: Sumatra (W Coast), Java (widespread, especially in the W), Celebes (Malino), Philippines (Palawan), ? Sumbawa (*Ploem s.n.*, L sh. 926.140-174, sterile).

Habitat — Poor soil; 40–1600 m altitude.

Notes — Nees apparently around 1834 sent around lists of names and descriptions to a.o. Buse, Steudel, Trinius, and Wight, who attributing them to Nees used them in their publications. Only Wight (Cat. Indian Pl. (1834)) specifically acknowl-

edged Nees's contribution, so the names there are to be cited 'Nees in Wight'. Unfortunately the majority are *nomina nuda*. In the other cases there is only external evidence of the source of this information. Thus Art. 46.6 applies and the names must be cited as 'Nees ex ...'.

In Wight's catalogue there appear several species of *Arundinella*, some of which have *Acratherum* as an infrageneric indication. These were cited by Steudel (1840: 21, 143) as synonyms of *Arundinella* spp. One of these is *Arundinella (Acratherum) fuscata* Nees (*Wight Cat. 1667*, probably the same as the *Wight Herb. Propr. 183* cited by Janowski (1922: 26). A duplicate of this is in the *Trinius Herbarium 405.1*).

The validation of *Arundinella fuscata* Nees was by Buse (1854, preprint: 19). However, no specimens or provenance were given, only a var. *β. 'angustiore'*, which word from the typography is not a name, but a remark. The specimens mentioned for this (in L) are all marked *β* on their labels. One (sh. 908.83-1332) has the combination in what appears to be Nees's handwriting.

Steudel, very shortly afterwards (1854a: 114), used *Arundinella fuscata* again, merely stating 'Penins. Ind. or.', but because of the above obviously meaning the Wight collection.

Note that Buse's and Steudel's *A. fuscata* are not true isonyms, as they are heterotypic, being based on different specimens in different institutes, but according to Art. 9. Note 2(c) they would be.

Hooker (1896: 74) correctly attributed the combination to Buse, and now we see that *Wight Cat. 1667* came from the Nilgiris of S India. Bor (1955: 406, 1960: 424, as *A. purpurea* Hochst. ex Steud.), wrote that it is an endemic of that area.

Obviously, it has been thought that a name used in a Malesian account could not be applied to a Nilgiri endemic, hence Hooker's use is cited as 'non Nees ex Buse', and another combination is used. I hope to have now shown that it is actually the other way around: Buse used a description for an Indian species and applied it to what he thought was an aberrant form from Java. Anyway, Buse validated *Arundinella fuscata*, whereby Hooker's use of it for the Indian species was correct (as so often) and must replace the later *A. purpurea*.

*Arundinella fuscata* can therefore not be used for our Malesian endemic. The specimens of Buse's *β* belong to a species for which the oldest name is *A. goeringii* Steud., which has been rarely used (e.g. in Boldingh 1916: 94, Janowski 1922: 23, 26, Keng 1936: 5, 37, t. 17). There is often some confusion about the provenance of Goering collections: Japan or Java? But the type of this one is the Malesian species and came from Java.

### 4. *Arundinella holcooides* (Kunth) Trin.

*Arundinella holcooides* (Kunth) Trin. (1836) 107. — *Brandtia holcooides* Kunth (1831) 511, t. 170. — Type: *Raynaud A' 1828* (? B or P, not found, cf. Bor (1955: 414); L).

*Arundinella agrostoides* Trin. (1830) t. 265. — Lectotype: *Anon. 'Manila'* (holo LE n.v., not in *Herb. Trin.*; K, sh. 290214, p.p.; 290215), 290215 designated by Teerawatananon (2009).

*Arundinella hirsuta* Nees ex Steud. (1854a) 115, # 13 (non #16). — Lectotype: *Gomez s.n. in Wallich 8671* (holo P; K, sh. 245950, 290214, p.p.; K-W: IDC microfiche 7394; W, fragm.), here designated.

*Arundinella birmanica* Hook.f. (1896) 73. — Lectotype: *Kurz 3161* (holo K), designated by Bor (1955: 413).

*Arundinella pubescens* Merr. & Hack. in Hack. (1907b) 419; ex Janowski (1922) 23, 27. — Type: *BS 856 (Foxworthy)* (holo W; L, NY, US; PNH†).

*Arundinella fuscata* Nees ex Buse var. *celebica* Jansen (1953) 233. — Type: *Bünnemeijer 11718* (holo BO; K, L, U).

*Arundinella ciliata* auct. non Miq.

*Arundinella hispida* auct. non Kuntze.

*Arundinella holcooides* (Kunth) Trin. var. *ciliata* auct. non Jansen.

*Arundinella setosa* auct. non Trin.



Plants annual. *Culms* tufted to more or less solitary, erect to ascending, 0.06–0.65 m long. *Nodes* bearded, rarely glabrous. *Sheaths* pilose with bb hairs to glabrescent to glabrous, or margins hairy (in *A. agrostoides*). *Throat* glabrous or hairy. *Ligule* 0.2–0.8 mm high. *Blades* flaccid, flat, lanceolate to linear, 1.5–26 cm by 2.25–14 mm, pilose on both sides or glabrescent or glabrous (in *A. agrostoides*), margins pilose or smooth (in *A. agrostoides*). *Peduncle* glabrous to pilose under the panicle. *Panicle* loosely contracted to fairly lax, interrupted at base, 1.5–32 by 1–8 cm, lowermost branches 1–3 together, longest one 0.5–9 cm long, angular, scaberulous, rarely smooth, sparsely pilose, rarely glabrous. *Pedicels* smooth to scaberulous to sparsely pilose. *Spikelets* (2.2–)2.7–5.6 mm long, whitish with green nerves, greenish, yellowish, or purple suffused. *Glumes* sparsely pilose or glabrous (in *A. agrostoides*); lower glume 1.2–3.8 mm long, 0.44–0.8 times as long as the spikelet, slightly shorter to slightly longer than the lower lemma, apex acuminate or mucronate, 3- or 5-nerved; upper glume 5- or 7-nerved, apex long-acuminate. Lower lemma neuter, male, female, or bisexual, 1.5–4 mm long, 3- or 5-nerved, apex acute; upper lemma 1–2.3 mm long, castaneous in fruit, microscopically scaberulous (40×!), 0-nerved, callus puberulous, hairs 0.1–0.6 mm long, 0.1–0.4 times as long as the lemma, apex acute, without lateral setae, awn distinctly exerted beyond the glumes, geniculate, 2.5–6.5 mm long when dry, column 1.2–3 mm long when dry. *Anthers* 3, 0.3–1 mm long.

Distribution — India, W Bengal (Calcutta, *Rel. Helf.* 157, L, PR), Burma: Bago Div. (= Pegu; *Raynoud A.* 1828, L; *Scott s.n.*, K), Yangon (= Rangoon; *McClelland 4 Jan. 1854*, K); Insein, Mingladon, Mon State: (Mawlamyine = Moulmein); Ayeyarwaddy (= Irrawaddy Prov., Bassein Distr., Thabound: *Dickson 8301*, A, L, RANG), Tanintharyi (= Tenasserim) Div.: Dawei (Tavoy: *W. Gomez in Wallich 8671*, IDC microfiche, K, P, W); Tawer, Kanbauk (*Maxwell 98-1183*, *98-4266*, CMU, L); Mergui; unknown (Pazwoandoung; *Kurz 1132*); ? Thailand (Peninsular: Ranong; Nanakorn & Norsangsri 2001: 38, cite *A. birmanica*), Vietnam: highlands of Chlong and Dong Nai ('Donnai', 700–1200 m alt., fide Schmid 1958, sub *A. birmanica*); *Poilane 24007*, L, P), Danang (*d'Alleizette 2 June 1909*, L), Nha Trang (*d'Alleizette 6–9 June 1909*, L); Malesia: SW Celebes (Bonthain, Lombasang), Philippines (Luzon: Abra Prov., Daguioman; Mountain Prov. Bagoio/Bontoc; Rizal: Fort Kckinley; Zambales: Mt Tapolao), Mindoro (Oriental, Rizal), Palawan (Iwahig, Victoria Mts), Lesser Sunda Isl. (Timor, see note).

Habitat — Steep slopes, grass land, logged over pine forest, degraded thicket and weed area, poor soils, 25–1890 m altitude. According to Rhind (1945: 41) frequent in Burma in the moister parts all over the plains.

Collector's notes — Culms tufted, blades green above, light green underneath, inflorescence axes dull green, spikelets pale light green to violet with green nerves, awns violet.

Notes — Trinius (1830) implied the presence of at least two syntypes: 'Manila', and 'wahovensi'. I presume the latter is derived from 'wahov' = Oahu = Hawai'i, which then is a mislabeling, as *Arundinella* does not occur there.

The combination is sometimes cited as 'non Hochst.'. The latter is a *nomen nudum* originally cited in the synonymy of *A. setifera* Steud., which is a synonym of *A. setosa*.

In vain have I tried to find distinctions between the Burmese, Vietnamese, and Central Malesian populations and in the end was forced to unite them, which results in a curiously disjunct distribution.

Although Touraine and Nha Trang were well-known localities in her time, apparently no material was available to Camus & Camus for their treatment in the *Flore de l'Indo-Chine* (1922).

Moulik (1997: 57) mentioned the presence of *A. holcooides* also for Madhya Pradesh, Maharashtra, Karnataka, Tamil Nadu, Kerala. The latter three no doubt are a confusion with *A. ciliata*, the first two I cannot explain.

*Arundinella agrostoides* differs mainly by the glabrous sheaths and leaf blades with smooth margins, and rather small spikelets (2–3.2 mm long) and seems to be a local form of Luzon.

*Arundinella hirsuta* is based on a mixture of things: the lectotype came from Tavoy (now Dawei) in Burma, and unnamed collections from the Himalaya and Courtallum (which is in SW Tamil Nadu). No form of the *A. ciliata*-complex is known to me from the Himalayas, while Courtallum suggests *A. ciliata* s.str., with which e.g. Bor has equated it.

*Arundinella hirsuta* sensu *Hohenacker 920* from the Nilgiris (Steudel 1854a: 115, in syn. sub # 16, *A. setifera*) is *A. setosa*.

The type specimens of *A. pubescens* in W and the original description differ in some details, e.g. I have seen no male first lemmas, only sterile ones. As in *A. agrostoides* the glumes are glabrous. It is said to occur in Taiwan as well (Kuoh & Chen 2002: 443, Sun & Phillips 2006: 569), but the collections seen belong to *A. filiformis*.

Jansen described *Arundinella fuscata* var. *celebica* on two collections: *Bünnemeijer 11718* from Celebes, and *Kuntze 4805* from Java. Bünnemeijer's specimens (BO, K, L, U) are stout examples of *A. holcooides*, Kuntze's specimens (K, NY) belong to *A. goeringii*. For Timor only known by *Teijsmann 8947* (BO), while in L (incl. fragm. in Herb. Hackel) there is a specimen in the Herb. Balansa (L 908.93-24) which may be a duplicate of this.

##### 5. *Arundinella nepalensis* Trin.

*Arundinella nepalensis* Trin. (1826) 62; (1830) t. 268. — Type: *Wallich ex Herb. Lindley in Herb. Trin.* 402.1 (holo LE, IDC microfiche BT-16/1; very likely the same as 8666-A, CGE, K, IDC microfiche 7394).

*Acratherum miliaceum* Link (1827) 230. — *Arundinella miliacea* (Link) Nees (1840: 417, 447, in passim), (1850) 102; Druce (1917) 605, isonym. — Type: 'Nepal' (B†, Scholz in litt.; ? K, LE, *Herb. Trin.* 402.2, IDC microfiche BT-16/1).

For further synonymy see Bor (1955: 404).

Plants perennial. *Culms* tufted, erect, 0.6–2(–3) m long. *Nodes* glabrous to bearded. *Sheaths* usually glabrous and margins hairy. *Throat* hairy. *Ligule* 0.2–1 mm high, ciliate. *Blades* flaccid to rather stiff, flat to involute, linear, 8–50 cm by 3–18 mm, glabrous to pilose on both sides, margins scaberulous. *Peduncle* under the panicle usually glabrous, sometimes with a few hairs. *Panicle* densely contracted to fairly lax, interrupted at base or not, 10–60 by 5–7(–13) cm wide, lowermost branch solitary, 3.5–16 cm long, angular, smooth to scaberulous, not pilose. *Pedicels* smooth to scaberulous. *Spikelets* (3.4–)4–6 mm long, greyish green or purple. *Glumes* glabrous, rarely setose; lower glume 2.6–5 mm long, 0.64–0.86 times as long as the spikelet, distinctly shorter than the lower lemma, apex acute, acuminate, or mucronate, 3-nerved; upper glume 5-nerved, apex acuminate to long-acuminate. Lower lemma neuter or male, (2.3–)2.7–3.6 mm long, 5-nerved, apex acute; upper lemma 1.7–2.5 mm long, castaneous in fruit (whitish in flower), smooth or microscopically scaberulous (40×!), 0-nerved, callus hairs 0.3–0.5 mm long, 0.16–0.33 times as long as the lemma, apex acute, without lateral setae, apex of the pedicels not setose, awn distinctly exerted beyond the glumes, geniculate, 2.7–6 mm long when dry, column 0.7–3.2 mm long when dry. *Anthers* 3, 0.7–1.7 mm long. 2n = 20, 40, 54, 60.

Distribution — Because of all the misapplications not quite certain. Very variable: see remarks by Bor (1955: 406): Africa (widespread), Madagascar, Arabia, N Pakistan, Bhutan, Nepal, Sikkim, India (widespread), Burma, Thailand (Chiang Mai),

Vietnam, China (widespread), Australia (W Australia, N Territory, New South Wales, Queensland).

Note — Although occurring north and south of Malesia, it has so far not yet been found there. All reports have turned out to be misapplications to *A. filiformis*, *A. furva*, or *A. goeringii*.

## 6. *Arundinella pumila* (Hochst. ex A.Rich.) Steud.

*Arundinella pumila* (Hochst. ex A.Rich.) Steud. (1854a) 114. — *Acratherum pumilum* Hochst. ex A.Rich. (1851) 414. — Lectotype: Schimper 642 (holo B; K, P), designated by Van der Zon (1992: 361). Phillips (1995: 285) stated that the holotype is in P, which is more logical as that is where Richard's main herbarium is.

*Arundinella effusa* C.E.Hubb. (1957) 63 (Clayton 1972: 414, in syn.). — Type: FHI 28524 (Keay & Russell) (holo K).

*Arundinella tenella* Nees & Wight ex Steud. (1840) 143, nom. nud. ex Steud. (1854a) 115. — (*Anemagrostis tenella* Wight ex Steud. (1854a) 115, in syn.). — Lectotype: Wight Herb. Propr. 76 =? Cat. 1668 (holo P; K, LE (Herb. Trin. 405.5, IDC microfiche BT-16/1)); 'Herb. Wight', partly designated by Bor (1955: 403), designated here.

Plants annual. Culms more or less solitary, erect, geniculate at base, 0.04–0.45 m long. Nodes puberulous. Sheaths glabrous to margins hairy to pilose with bb hairs. Throat glabrous. Ligule 0.8–1 mm high. Blades flaccid, flat, oblong to linear, 1.7–20 cm by 2–20 mm, glabrous to sparsely pilose on both sides, margins smooth to scaberulous. Peduncle glabrous under the panicle, rarely with a few hairs under the panicle. Panicle effuse, not interrupted at base, 2–33 by 1–22 cm, lowermost branches 1–6 together, longest one 3–20 cm long, terete (filiform), smooth, not pilose, rarely or sparsely pilose. Pedicels smooth. Spikelets 1.5–2.2 mm long, whitish with green nerves. Glumes glabrous, or the upper one with a few hairs; lower glume 1–1.6 mm long, 0.55–0.76 times as long as the spikelet, slightly shorter than to about as long as the lower lemma, 1- or 3-nerved apex acuminate or mucronate; upper glume 1–5-nerved, apex acuminate to long-acuminate. Lower lemma neuter, male, or bisexual, 1.3–1.4 mm long, 1–5-nerved, apex acute; upper lemma 0.8–1 mm long, castaneous in fruit, minutely scaberulous (40×!), 0-nerved, callus hairs 0.1–0.2 mm long, 0.13–0.28 times as long as the lemma, apex acute, without lateral setae, awn distinctly exerted beyond the glumes, geniculate, 2–3.4 mm long when dry, column 0.7–1.4 mm long when dry. Anthers 3, 0.3–0.5 mm long. 2n = 24.

Distribution — W to E Africa, Oman, India to Malesia: Java (very rare in Pasuruan, once in W Java, Pryer A° 1900, B, L), SW Celebes, Lesser Sunda Isl. (Flores, Lombok, Sumbawa).

Habitat — Shady, humid places, steep roadsides, moist stones, base of waterfall, locally common, 700–1350 m altitude.

Note — Distribution disjunct. Technically very close to *A. holcoides*, but usually easily recognised by the effuse panicle that has the base still inside the sheath of the flag leaf.

## 7. *Arundinella setosa* Trin. — Fig. 1

*Arundinella setosa* Trin. (1826) 63. — Type: Wallich & Rudge s.n. e Herb. Lindley in Herb. Trinius 404.1 (LE, IDC microfiche BT-16/1; CGE), Nepal, but not identical with Wallich 8666-A (*A. nepalensis* Trin.) or 8669-A (syn-type of *A. wallichii* Nees ex Steud.: 114 = *A. bengalensis* (Spreng.) Druce). [*Agrostis biseta* Spreng. ex Steud. (1840) 39, 143, in syn. sub *Arundinella indica* Trin., nom. nud. — (*Arundinella sprengelii* Trin., nom. ined.) — Voucher: Roxburgh e Herb. Spreng. in Herb. Trinius 406.2 (LE, IDC microfiche BT-16/1)].

?*Miquelia barbulate* Nees (1841) 46 (preprint); (1843) 178. — *Berghausia barbulate* (Nees) Endl. ex Miq. (1851) 32. — *Garnotia barbulate* (Nees) Merr. (1918) 130; Janowski in Janowski & Mez (1921) 86, isonym. — Type: Meyen s.n. 'Promonorium Syng-moon Imp. Sinensis' (holo B†; perhaps in BM, BR, CAS, CGE, K, KIEL, LE).

*Arundinella stricta* Nees (1850) 102. — *Danthonia luzoniensis* Steud. (Apr. 1854a) 245, nom. superfl. — *Arundinella setosa* Trin. var. *stricta* Pilg. (1904) 140. — Type: Cuming 1415 (holo CGE; K, P).

*Arundinella tricuspidula* Buse in Miq. (Feb. 1854) preprint: 20; (Aug. 1854) 360; Janowski (1922) 27 ('*tricuspidata*'). — Type: Horner s.n. 'Sumatra, Padang Lawas' (holo L, sh. 902.23-97).

*Arundinella tricuspidula* Buse var. *obscurior* Buse in Miq. (Feb. 1854) preprint: 20; (Aug. 1854) 360. — Type: Reinwardt s.n. (holo L, sh. 902.23-96). *Arundinella setifera* Steud. (1854a) 115. — Type: Hohenacker 920 (holo P; K, L).

*Arundinella hirsuta* Nees ex Steud. (1854a) 115. — Type: Wallich Cat. 8671 (holo K, IDC microfiche 7394).

*Arundinella mutica* Nees ex Steud. (1854a) 116. — *Arundinella capillarum* Hook.f. (1896) 74, nom. superfl. — Type: Heyne in Herb. Wallich 8665-A (holo P; K, IDC microfiche 7394).

*Arundinella zollingeri* Steud. (1854a) 115 ('2034'); (1854b) 59. — Type: Zollinger 2834 (holo P, 01856819; BM), designated here.

*Danthonia neurolytrum* Steud. (1854a) 245. — Type: Fortune 5 (holo P). [*Milium cimicinoides* Roxb. ex Hook.f. (1896) 70, in syn. sub *A. setosa*. — Voucher: Roxburgh (K)].

*Arundinella lasiostoma* K.Schum. (1900) 174. — *Arundinella setosa* Trin. var. *lasiostoma* Jansen (1953) 235. — Type: Lauterbach 2744 (holo B†).

*Arundinella sinensis* Rendle (1904) 342. — Syntypes: Ford 125, 201, 212 (K). *Arundinella lasiostoma* K.Schum. var. *hirsutissima* Pilg. (1905) 56. — Type: F.H. Brown 188 (holo B†; NSW).

*Arundinella setosa* Trin. var. *cullionensis* Jansen (1953) 235. — Type: Bartlett 15532 (holo MICH).

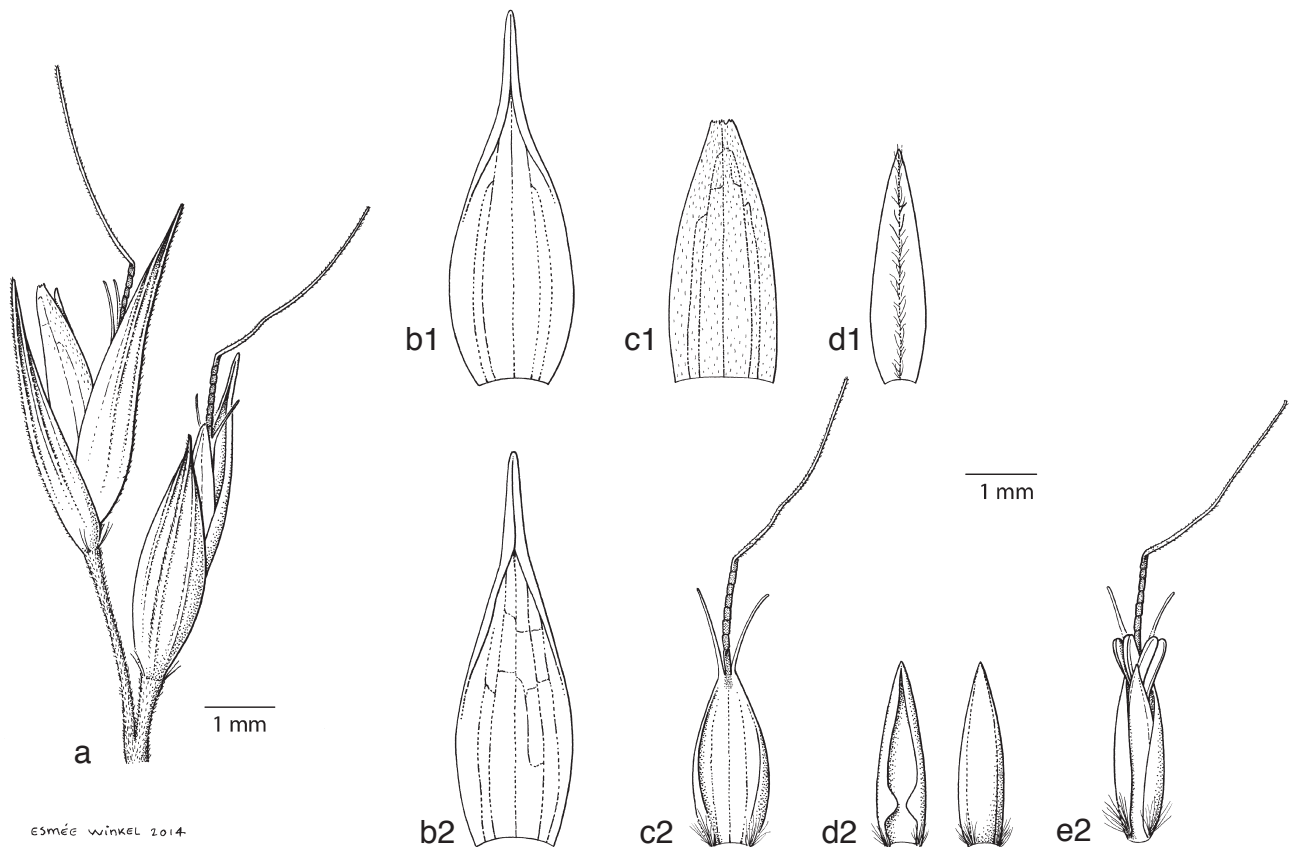
*Arundinella setosa* Trin. var. *esetosa* Bor (1960: 425, sine typo) ex S.M.Phillips & S.-L.Chen (2005) 468. — Type: T. Thomson s.n. (holo K).

Plants perennial. Culms tufted, erect, 0.6–1.5(–2.1) m long. Nodes glabrous. Sheaths glabrous or margins hairy (see note). Throat glabrous or hairy. Ligule 0.3–1 mm high. Blades flaccid or rather stiff, flat or involute, linear, 16–42 cm by 3–9 mm, glabrous, margins scabrous. Peduncle glabrous under the panicle. Panicle loosely contracted, not interrupted at base, 10–45 by 1–9 cm, lowermost branch solitary, 6–25 cm long, angular, scabrous, not pilose. Pedicels scabrous, apically setose. Spikelets 4.5–7 mm long, greenish, yellowish, or purple suffused with green nerves. Glumes glabrous; lower glume 3.5–6 mm long, 0.67–0.89 times as long as the spikelet, distinctly longer than the lower lemma, apex acuminate to mucronate, 3-nerved; upper glume 5-nerved, apex long-acuminate. Lower lemma neuter (paleate) or male, 3.2–4.5 mm long, 3(–7)-nerved, apex acute; upper lemma 2.2–3.25 mm long, castaneous in fruit, microscopically scaberulous (40×!), 0(–3)-nerved, callus hairs 0.5–0.8 mm long, 0.23–0.32 times as long as the lemma, apex acute, apex with lateral setae (up to 3 mm long), rarely without, awn distinctly exerted beyond the glumes, geniculate, 5.2–9.1 mm long when dry, column 1–3 mm long when dry. Anthers 3, 1.3–1.7 mm long. 2n = 20, also 16, 32, 48, 54, 80.

Distribution — India (Kerala to NE) to China (widespread), Taiwan, N Australia (W Australia, N Territory, Queensland); Malesia: Sumatra, Malay Pen. (Kedah, Kelantan), Java, Borneo (S Kalimantan, Kab. Banjar, Soekisman 52, BIOT), Celebes (Lombasang, Masamba), Kabaena, Philippines (Busuanga, Cullion, Luzon, Manamoc Isl., Mindanao), Lesser Sunda Isl. (Bali, Flores, Timor), New Guinea: Irian Jaya (Baliem, Jayapura), Papua New Guinea (Central, Chimbu, Enga, E-, W Highlands, Madang, Milne Bay, Morobe, W Sepik Prov.).

Habitat — Sunny, dry, often less fertile soils (clay, granite, laterite, peat, sand stone, volcanic), fire-damaged areas. Mixed-deciduous or evergreen Dipterocarp-Oak, Pine, *Casuarina*, *Eucalyptus*, sclerophyllous (with e.g. *Actinodaphne*, *Calamus*, *Daphniphyllum*, *Melastoma*, *Meliosma*) forests, secondary grasslands with e.g. *Crotalaria anagyroides* Kunth, *Mimosa diplotricha* Sauvalle, *Tephrosia vogelii* Hook.f., *Chloris barbata* Sw., *Eragrostis tenuifolia* (A.Rich.) Steud., *Heteropogon contortus* (L.) Roem. & Schult., *Imperata cylindrica* (L.) Raeusch., *Melinis minutiflora* P.Beauv., *Paspalum conjugatum* P.J.Bergius, *P. paniculatum* L., *Pennisetum polystachion* (L.) Schult., *Themeda triandra* Forssk., *Urochloa maxima* (Jacq.) R.D.Webster. Locally numerous, sometimes vegetation forming. 0–2030 m altitude.





**Fig. 1** *Arundinella setosa* Trin. a. Spikelets; b1. lower glume; c1. first lemma; d1. first palea; b2. upper glume; c2. second lemma; d2. second palea (ventral, dorsal); e2. second floret (note 3 anthers) (all Veldkamp 7101, L).

Collector's notes — Tufted perennial. Roots pale brown. Culms green. Sheaths pale brown. Blades flat, green to somewhat dull violet above, pale green beneath. Inflorescence axes pale to medium green, often dull dark violet. Glumes pale green, often with dark pink, brown, dull maroon, purple, with green or black nerves, turning tan. Lemmas, paleas white. Columns brown, dull maroon, setae pale green, tan. Filaments white, anthers yellow, dark violet. Stigmas dark purple.

Notes — Immediately recognisable by the coronula under the spikelet and the two setae at the base of the awn. However, the latter are very variable in length and sometimes minute to lacking (var. *esetosa*) and if not immediately found several spikelets should be inspected. In Malesia, too, specimens with microscopic or no setae were seen, so it would appear that this form is merely an extreme in a range and not worth of recognition.

*Miquelia barbulata* is tentatively included here, as no authentic material has been seen, while it must be noted that Merrill (1918) equated it with *Garnotia patula*.

Jansen (1953: 235) erroneously regarded *Schlechter 18422* as the type of *A. lasiostoma*. Indeed, as he said, the differences with the typical form are inessential for the recognition at any rank.

Plants are usually quite glabrous, LAE 72431 (*Henty*) (BRI, L, LAE) is except for the inflorescence exceptionally hairy.

## OTHER SPECIES

Other species had to be studied in the revision because they had been mentioned for Malesia or have been confused with Malesian taxa. One seems to be undescribed. It seemed a waste not to include the information gleaned in this way.

## 1. *Arundinella ciliata* Nees ex Miq.

*Arundinella ciliata* Nees [in Wight (1834) 97, nom. nud.] ex Miq. (1851) 30 ≡ (1851) 30; Drury (1869) 592, isonym. — *Arundinella agrostoides* Trin. var. *ciliata* Kuntze (1891) 761. — Lectotype: *Wight Cat. 1666* (holo U (now L); K) implicitly appointed by Bor (1955: 412) (see note), designated here. *Holcus ciliatus* Roxb. (1814: 82, nomen) (1820) 321. — [*Arundinella agrostoides* Trin. (1830) var. *ciliata* Hook.f. (1896) 71, nom. superfl., non Kuntze (1891)]. — [*Arundinella holcoides* (Kunth) Trin. var. *ciliata* Hook.f. ex Nees' ex Rhind (1945) 41, nom. superfl.; ('Roxb.') Jansen (1953) 231, idem, isonym]. — Type: *Roxburgh s.n.* (holo BM; *Icon. Ined. 2031*, CAL, K). *Arundinella pilosa* Hochst. ex [Miq. (1851) 30 ≡ (1851) 30, in syn. sub *A. ciliata*] Steud. (1854a) 116. — *Arundinella anomala* Steud. var. *pilosa* Honda (1922) 111. — Type: *Hohenacker (Metz) 647* (holo P; K, L, U (now L)). *Arundinella agrostoides* auct. non Trin. *Arundinella holcoides* auct. non Trin.

Plants annual. Culms tufted, erect, 0.15–0.42 m long. Nodes bearded. Sheaths pilose with bb hairs. Throat glabrous. Ligule 0.3–0.7 mm high. Blades flaccid, flat or infolded, linear, 4–19 cm by 3–10 mm, pilose on both sides, base rounded, margins pilose. Peduncle under the panicle glabrous to pilose. Panicle densely contracted to contracted, 6–18 by 1–3 cm, lowermost branch solitary, 1–4.5 cm long, angular, scaberulous, glabrous to sparsely pilose. Pedicels scaberulous, apex not setose. Spikelets 2.8–3.8 mm long, greenish, yellowish, or purple suffused. Glumes sparsely pilose; lower glume 1.8–3.3 mm long, 0.53–0.94 times as long as the spikelet, distinctly longer than the lower lemma, apex mucronate, 3- or 5-nerved; upper glume 5-nerved, apex long-acuminate. Lower lemma neuter, male, female, or bisexual, 1.5–2.4 mm long, nerves 3, not anastomosing, apex acute; upper lemma 1–1.4 mm long, brownish (mature?), smooth to scaberulous, 0-nerved, callus hairs 0.3–0.5 mm long, 0.21–0.42 times as long as the lemma, apex acute, without lateral setae, awn distinctly exerted beyond the glumes, geniculate, 3.6–4.3 mm long when dry, column 1.4–1.7 mm long when dry. Anthers 3, 0.3–0.5 mm long.  $2n = 18, 20$ .

Distribution — S India: Annamalais and Nilgiri Hills of Karnataka, Kerala, and Tamil Nadu.

Habitat — Roadsides, moist rocky places, slopes, 1050–1800 m altitude.

Notes — Miquel (1851) and Kuntze (1891) only referred to Nees in Wight (1834) and not to Roxburgh (1814, 1820), therefore the combinations *Arundinella ciliata* Nees ex Miq. and *Holcus ciliatus* Roxb. are heterotypic. Nees cited Wight 1666, Hochstetter (Metz) 647, Miquel cited both and explicitly (in a footnote) stated that names proposed by Nees had priority over those by Hochstetter. Wight 1666 therefore is the lectotype with the holotype in U (now L), and Hochstetter (Metz) 647 a syntype. Moulik (1997: 56) mentioned the presence of this species also in Maharashtra. I do not know on what this was based.

## 2. *Arundinella fuscata* Nees ex Buse

*Arundinella fuscata* Nees ex Buse in Miq. (Feb. 1854) preprint: 19; (Aug. 1854) 359; Nees ex Steud. (1854a) 114, isonym. — (*Arundinella* (*Acratherum*) *fuscata* Nees in Wight (1834) 97, nom. nud.). — (*Acratherum fuscatum* Nees ex Steud.: B.D.Jacks. (1895) 32, nom. inval., in syn.). — Type: Wight Cat. 1667 ≡ Wight Herb. Propr. 183 (holo U (now L); K, LE (*Herb. Trin.* 405.1, IDC microfiche BT-16/1), P). Both not in B (Scholz, 16 July 2003, pers. comm.).

*Arundinella purpurea* Hochst. ex Steud. (1854a) 115. — Type: *Hohenacker 928* (holo P; G, K, L, M, U (now L), US].

*Arundinella purpurea* Hochst ex Steud. var. *laxa* Bor (1955) 407. — Syntypes: *Gamble 13365, 20617* (K), Madras, Nilgiri, Sispara.

Plants perennial. Culms tufted, erect to geniculate at base, 0.35–0.85 m long. Nodes glabrous, puberulous, or bearded. Sheaths puberulous to densely pilose with bb hairs, glabrescent. Throat hairy. Ligule 0.4–1 mm high, glabrous or ciliolate. Blades flaccid to rather stiff, flat or involute, linear, 4.5–30 cm by 3–15 mm wide, usually pilose on both sides, margins scaberulous. Peduncle pilose under the panicle. Panicle densely contracted, rarely fairly lax, not interrupted at base, 3–20 by 1.5–2.5 cm, lowermost branch solitary, 1–4 cm long, angular, scabrous to puberulous, not pilose. Pedicels scaberulous and puberulous. Spikelets 3–4.5(–5.5) mm long, purple suffused. Glumes glabrous; lower glume 2.2–4 mm long, 0.59–0.75 times as long as the spikelet, slightly shorter than the lower lemma, apex acute, 3-nerved; upper glume 5-nerved, apex long-acuminate. Lower lemma neuter or male, 2.6–4 mm long, 3- or 5-nerved, apex acute; upper lemma 1.5–2 mm long, castaneous in fruit, microscopically scaberulous (40×!), 0-nerved, callus glabrous or puberulous, hairs 0.3 mm long, callus hairs 0.15 times as long as the lemma, apex acute, without lateral setae, awned or mucicous, awn distinctly exerted beyond the glumes, geniculate, 3–6 mm long when dry, column 1–2 mm long when dry. Anthers 3, 0.75–1.8 mm long.

Distribution — S India: Karnataka, Kerala, Tamil Nadu.

Habitat — Open pastures, road cuttings, marshes often with *A. vaginata* Bor and *Eulalia phaeothrix* (Hack.) Kuntze, river bed, 1040–2500 m altitude.

Notes — Here we have a problem that by lack of material I cannot solve and gladly delegate to Indian botanists.

Species have been distinguished by the presence of an awned upper lemma and hairs on the callus.

In the isotype of *A. fuscata* (U) there is an awn and the callus is puberulous. Using the keys of Bor (1955, 1960) and Sreekumar & Nair (1991) this would belong to what they call *A. purpurea*.

Among the 5 isotypes of *A. purpurea* there were inflorescences with no or very few awned upper lemmas, and others with predominantly awned ones. It is not, as Steudel presumed, because the awns have fallen off. The only other collection available, *Perrotet 1231* from the Nilgiris, was a similar mixture. In these collections the calli were glabrous.

I have assumed that all are conspecific.

Some spikelets of the var. *laxa* are proliferous. It is noted to grow together with the typical variety, so one wonders whether it should be distinguished, and a new combination is not proposed here.

## 3. *Arundinella hispida* (Kunth ex Willd.) Kuntze

*Arundinella hispida* (Kunth ex Willd.) Kuntze (1891) 761; Hack. (1904) 527, isonym. — *Andropogon hispidus* Kunth ex Willd. (1806) 908. — *Ischaemum hispidum* (Kunth ex Willd.) Kunth (1816) 194. — Type: *Humboldt & Bonpland s.n.* (holo P-BONPL, fragm in US).

*Goldbachia mikanii* Trin. in Spreng. (Jan. 1821) 81, nom. incorr. ('*mikani*'). — [*Riedelia mikanii* Trin. ex Nees (1829) 465, in syn.; ex Kunth (1833) 515, in syn.] — *Arundinella mikanii* Nees (1829) 465, nom. superfl. — Type: *Mikan s.n.* (holo not in Herb. Trin., fide IDC microfiche BT-16/1; iso possibly in W). *Arundinella brasiliensis* Raddi (1823) 37, t. 1, f. 3. — Type: *Raddi s.n.* (holo Pl, BM, fragm., *Herb. Trin.* 398.2, LE, IDC microfiche BT-16/1).

See Soreng & Pennington (2003: 112) for more extensive synonymy and references.

Plants perennial. Culms tufted, erect, 0.75–2 m long. Nodes glabrous, puberulous, or bearded. Sheaths pilose to pilose with bb hairs. Throat hairy. Ligule 0.2–0.3 mm high, glabrous. Blades rather stiff, flat to involute, linear, 15–27 cm by 7–16 mm, glabrous to pilose on both sides, margins scaberulous. Peduncle glabrous under the panicle. Panicle loosely to densely contracted, usually interrupted at base, 9–40 by 3–7 cm, lowermost branches 1–15 together, longest one 8–20 cm long, branches angular, scaberulous, glabrous. Pedicels scaberulous, apex not setose. Spikelets 2.8–4.2 mm long, yellowish or purple. Glumes glabrous; lower glume 2–2.9 mm long, 0.7–0.76 times as long as the spikelet, about as long as the lower lemma, apex acuminate, 3- or 5-nerved; upper glume 3–7-nerved, apex long-acuminate. Lower lemma neuter (paleate) or male, 1.5–2.8 mm long, 3- or 5-nerved, apex acute; upper lemma 1.5–2 mm long, castaneous in fruit, microscopically scaberulous (40×!), 0-nerved, callus hairs 0.3–0.6 mm long, 0.2–0.37 times as long as the lemma, apex acute, without lateral setae, awn distinctly exerted beyond the glumes, geniculate, 1.7–6 mm long when dry, column 0.6–1.8 mm long when dry. Anthers 3, 0.5–0.9 mm long.

Distribution — Mexico to Paraguay, Argentine.

Habitat — Lowland savannahs to montane forest edges, edges of fields, 300–2000 m altitude.

Note — Records for Asia are misidentifications.

## 4. *Arundinella taiwanica* Veldk., sp. nov.

Culmi caespitiosi. Folia paulo rigida glabra. Paniculae laxae contractae ramis puberulis. Spiculae bruneolae ad purpureae suffusae. Lemmata inferiora 3.8–5 mm longa, superiora laevia aristis 2–3.1 mm longis (i.s.). — Typus: *Van Steenis 20656* (holo L), Taiwan, Hualien Co., Hsoulin Hsiang, Tayu Lin (locality now converted to a vegetable farm).

*Arundinella pubescens* auct. sin., non Merr. & Hack., p.p.: e.g. Kuoh & Chen (2002) 444, Sun & Phillips (2006) 569.

Plants perennial (cataphylls!). Culms tufted, erect, 0.25–more than 0.6 m long. Nodes glabrous. Sheaths glabrous, or margins hairy, or pilose with bb hairs. Throat hairy. Ligule 0.3–0.5 mm high. Blades rather stiff, flat to involute (ultimately articulating at base), linear, 5.5–15.5 cm by 0.8–5 mm, glabrous, margins smooth or scaberulous or pilose. Peduncle under the panicle glabrous. Panicle loosely contracted, 3.5–11.5 by 1–2 cm, lowermost branch solitary, 1.5–6.5 cm long, angular, puberulous, not pilose. Pedicels scaberulous or puberulous. Spikelets 4–5.7 mm long, purple suffused to brownish (when dry). Glumes glabrous; lower glume 2.8–4.7 mm long, 0.7–0.9 times as long as the spikelet, distinctly shorter than to about as long as the lower lemma, apex acuminate to mucronate, 3- or



5-nerved; upper glume 3–5-nerved, apex acuminate. Lower lemma male (not always seen, but paleate; anthers c. 1 mm long, black, abortive?), 3.8–5 mm long, 3- or 5-nerved, apex acute; upper lemma 2.4–3 mm long, castaneous in fruit, smooth, 3-nerved, callus hairs 0.5–1.4 mm long, 0.35–0.47 times as long as the lemma, apex acute, without lateral setae, awn distinctly exerted beyond the glumes, geniculate, 2–3.1 mm long when dry, column 0–1.1 mm long when dry. *Anthers* 3, 1.5–2 mm long.

Distribution — Taiwan, Hualien Co., Ta-yu-ling (N24°11'0" E121°18'0", type); Nantou, Jenai Hsiang, Yunhai (N24°3'0" E121°16'0"); Taitung Co., Hsiao-kuei Hu (N22°44'04" E120°53'44").

Habitat — Open, rather dry grassland, along a trail with *Miscanthus transmorrisonensis* Hayata, *Abies savannah*, 1800–2500 m altitude.

*Additional specimens seen.* C.-C. Hsu & R. Hsu 3637 (TAI, phoco in L), 3654 (TAI, phoco in L), M.-J. Jung x 022802 (L ex NCKU), M.-J. Jung 13453 (L ex NCKU), S.-Y. Ku 20410 (L ex NCKU), Nakamura T-4959 (TAI, phoco in L). Perhaps *Ohwi* 1424 (US) not seen by me, but mentioned by Phipps (1967a: 1047) belongs here.

Note — Most similar is *A. filiformis* (incl. *A. humilior*):

- . Panicle fairly lax to lax, branches smooth or scaberulous. Upper glume apex long-acuminate. Upper lemma 1–2 mm long, microscopically scaberulous (40×!), awn 3.5–7.3 mm long when dry. . . . . *A. filiformis*
- . Panicle loosely contracted, branches puberulous. Upper glume apex acuminate. Upper lemma 2.4–3 mm long, smooth, awn 2–3.1 mm long when dry. . . . . *A. taiwanica*

**Acknowledgements** Most of this study was based on specimens available in L and U, and some seen in BO, K, M, P, SING, and W. Loans of crucial importance from K, M, and W are gratefully acknowledged. Dr. R.J. Sorong (US) kindly inspected some of the specimens there. Messrs. M.-J. Jung and C.-S. Kuoh (NCKU) provided material and data for the study of *A. taiwanica*. Dr. A. Teerawatananon (Natural History Museum Thailand, National Science Museum, Technopolis, Thailand) sent me a pdf file of her thesis on Thai species, which was very much appreciated. Ms. Esmée Winkel (L) is much thanked for her fine line drawing.

## REFERENCES

Anonymous on the internet. Accessed 2 May 2013 [http://www.herbiguide.com.au/Descriptions/hg\\_Parramatta\\_Grass.htm](http://www.herbiguide.com.au/Descriptions/hg_Parramatta_Grass.htm).

Backer CA. 1936. Verklarend woordenboek van wetenschappelijke plantennamen: 5, 238, 585. Noordhoff, Groningen, Noordhoff-Kolff, Batavia, Visser & Co, Batavia.

Bentham G. 1881. Notes on Gramineae. Journal of the Linnean Society, Botany 19: 59, 85.

Bentham G. 1883. Gramineae. In: Bentham G, Hooker JD, Genera plantarum 3: 1075, 1080, 1118. Reeve & Co., Williams & Norgate, London.

Blake ST. 1941. Studies on Queensland grasses, II. University of Queensland, Department of Biology, Papers 1, 18: 16.

Bolding I. 1916. Zakflora voor de landbouwstreken op Java: 94. Kolff & Co., Batavia.

Bor NL. 1955. Notes on Asiatic grasses: XXIV. The genus *Arundinella* Raddi in India, Burma and Ceylon. Kew Bulletin [10]: 377–414.

Bor NL. 1960. The grasses of Burma, Ceylon, India and Pakistan: 417–426. Pergamon Press, Oxford, etc.

Brown R. 1814. Gramineae. In: Flinders M, A voyage to Terra Australis 2: 582. Nicol, London.

Buse LH. 1854. Gramineae. In: Miquel FAW, Plantae junghuhnianae 3 (Feb. 1854) preprint: 19–20; (Aug. 1854) 359–360. Sythoff, Leiden.

Camus EG, Camus A. 1922. Graminées. Flore generale de l'Indo-Chine 7: 521–529. Masson & Cie, Paris.

Chase A. 1943. Papuan grasses collected by L.J. Brass. Journal of the Arnold Arboretum 24: 85–86, t. 4.

Chenery EM. 1948. Aluminium in the plant world. Part I. General survey in dicotyledons. Kew Bulletin [3]: 173–183.

Chenery EM. 1949. Aluminium in the plant world. Part II. Monocotyledons and gymnosperms. Part III, Cryptogams. Kew Bulletin [4]: 463–473.

Clayton WD. 1972. Gramineae. In: Hutchinson J, Dalziel JM, Flora of West Tropical Africa, ed. 2, 3: 413–414. Crown Agents, London.

Clayton WD. 1981. Early sources of tribal names in Gramineae. Kew Bulletin 36: 484.

Clayton WD. 1989. Arundinelleae. Flora zambesiaca 10/3: 198–199. Flora Zambesiaca Managing Committee, London.

Clayton WD, Renvoize SA. 1986. Genera graminum. Kew Bulletin, Additional Series 13: 295, 315.

Conert HJ. 1957. Beiträge zur Monographie der Arundinelleae. Botanische Jahrbücher für Systematik 77: 226–354.

Correia RI de S, Lubke RA, Phipps JB. 1967. Estudos nas Arundinelleae (Gramineae). VII. Um novo género, três novas espécies e novas combinações. Boletim da Sociedade Broteriana II, 4: 191–202.

De Candolle AP. 1821a (20 Apr.). Mémoire sur la famille des Crucifères. Mémoires du Muséum d'Histoire Naturelle 7: 242 (repr. Aug. 1821: 74).

De Candolle AP. 1821b (late May). Regni vegetabilis systema naturale 2: 576. Treuttel & Würtz, Strasburg, London.

Debeaux O. 1879. Florule de Tsien-Tsin (province de Pé-tché-ly). Actes de Société Linnéenne de Bordeaux 33: 976 (repr.: 71).

Druce GC. 1917. Nomenclatorial notes: chiefly African and Australian. Second Supplement to Botanical Society & Exchange Club, Report for 1916: 605.

Drury H. 1869. Handbook of the Indian Flora 3: 592. Richardson & Co., London.

Elmer ADE. 1939. Miscellaneous new species. Leaflets of Philippine Botany 10: 3807. Manila.

Fournier E. 1886. Mexicanas plantas 2: 54. Typographeus republicae, Paris.

Goüan A. 1762. Hortus regius monspeliensis: 48, 547. De Tournes, Lyon.

Hackel E. 1887. Gramineae. In: Engler A, Prantl K, Die natürlichen Pflanzenfamilien 2, 2: 32. Engelmann, Leipzig.

Hackel E. 1896. The true grasses: 68. Holt & Co., New York.

Hackel E. 1904. Supplementa enumerationis graminum Japoniae, Formosae, Coreae. Bulletin de l'Herbier Boissier II, 4: 527.

Hackel E. 1906. In: Kneucker A, Bemerkungen zu den "Gramineae exsiccatae". Allgemeine Botanische Zeitschrift für Systematik 12: 179.

Hackel E. 1907a. In: Kneucker A, Gramineae Exsiccatae Lieferung 21: no. 606 (specimens in K, L, etc.).

Hackel E. 1907b. Two new Philippine grasses. Philippine Journal of Science 2: 419.

Harvey WH. 1868. The genera of South African plants, ed. 2: 428. Juta, Cape Town; Longman et al., London.

Herter WG. 1940. Plantae uruguayenses novae vel criticae. Revista Sudamericana de Botánica 6: 136.

Hitchcock AS. 1920. The genera of grasses of the United States, with special reference to the economic species. United States Department of Agriculture Bulletin 772: 18.

Hitchcock AS, Chase A. 1917. Grasses of the West Indies. Contributions from the United States National Herbarium 18: 290.

Honda M. 1922. Revisio graminum Japoniae. Botanical Magazine, Tokyo 36: 111.

Hooker JD. 1896. Flora of British India 7: 68–77. Reeve & Co., Brook nr. Ashford.

Huang J, Xia H, Zhi'an Li Z, et al. 2009. Soil aluminium uptake and accumulation by *Paspalum notatum*. Waste Management & Research 27: 668–675.

Hubbard CE. 1936. The genera of the tribe Arundinelleae. Bulletin of Miscellaneous Information: 317–325.

Hubbard CE. 1957. Notes on African grasses: XXVIII. New species from Tropical Africa. Kew Bulletin [12]: 63.

Jackson BD. 1895. Index Kewensis 1: 32. Clarendon, Oxon.

Janowski M. 1922. Arundinelleae, Graminum tribus, conspectus. Botanisches Archiv 1: 21–28.

Janowski M, Mez C. 1921. In: Mez C, Gramineae novae vel minus cognitae. II. Arundinelleae. Repertorium Specierum Novarum Regni Vegetabilis 17: 84–86.

Jansen P. 1953. Notes on Malesian grasses – I. Reinwardtia 2: 231–235.

Johns RJ, Stevens PF. 1971. Mount Wilhelm flora, a check list of the species. Botanical Bulletin, Lae 6: 10.

Keng Y-L. 1936. The Asiatic species of *Arundinella*. National Central University Science Reports, Series B, 2, 3: iii, 1–68.

Kunth CS. 1816 (May). In: Humboldt A, Bonpland A, Nova genera et species plantarum 1: 165, 194. Libraria graeco-latini-germanicae, Paris.

Kunth CS. 1822 (9 Dec.). Synopsis plantarum 1: 247. Levraut, Paris; Argentoratus, Strassburg.

Kunth CS. 1829. Révision des graminées 1: 133. Gide fils, Paris.

Kunth CS. 1830. Révision des graminées 1: 209. Gide fils, Paris.

Kunth CS. 1831. Révision des graminées 2: 511, t. 170. Gide fils, Paris.

Kunth CS. 1833. Enumeratio plantarum 1 ("Agrostographia"): 412, 515. Colla, Stuttgart, Tübingen.

- Kunth CS. 1834. Révision des graminées 1, Suppl.: xli. Gide fils, Paris.
- Kuntze O. 1891. Revisio generum plantarum 2: 761. Felix, Leipzig, etc.
- Kuoh C-S, Chen CH. 2002. Arundinella. In: Huang TC (ed), Flora of Taiwan, ed. 2, 5: 443–444. Editorial Committee of the Flora of Taiwan, National Taiwan University, Taipei.
- Li Y-HC, Lubke RA, Phipps JB. 1966. Studies in the Arundinelleae (Gramineae), IV. Chromosome numbers of 23 species. Canadian Journal of Botany 44: 387–393.
- Li Y-HC, Phipps JB. 1973. Studies in Arundinelleae (Gramineae). XV. Taximetrics of leaf anatomy. Canadian Journal of Botany 51: 657–680.
- Link JHF. 1827. Hortus regius botanicus berolinensis 1: 230. Reimer, Berlin.
- Lubke RA, Phipps JB. 1973. Taximetrics of Loudetia (Gramineae) based on leaf blade anatomy. Canadian Journal of Botany 51: 212–246.
- Luque Mirabal R, Lisená M, Luque Mirabal O. 2006. Vetiver system for environmental protection of open cut bauxite mining at “Los Pijiguaos” – Venezuela. 2006 International Conference on Vetiver in Caracas. English translation accessed 10 May 2013: <http://www.vetiver.org/ICV4-Rafael%20Luque.pdf>.
- Mangen J-M. 1993. Ecology and vegetation of Mt Trikora, New Guinea (Irian Jaya / Indonesia). Travaux scientifiques du Musée Nationale d'Histoire Naturelle de Luxembourg 21.
- Maximowicz CJ. 1859. Primitiae florum amurensis (1859) 328. Kaiserliche Akademie der Wissenschaften, St. Petersburg; Voss, Leipzig.
- McNeill J, Barrie FR, Buck WR, et al. 2012. International code of nomenclature for algae, fungi, and plants (Melbourne Code). Regnum Vegetabile 154.
- Merrill ED. 1918. Notes on the Flora of Loh Fau Mountain, Kwantung Province, China. Philippine Journal of Science, section C, Botany 13: 130–131.
- Metalí F, Salim KA, Burslem DFRP. 2012. Evidence of foliar aluminium accumulation in local, regional and global datasets of wild plants. New Phytologist 193: 637–649.
- Miquel FAW. 1851. Analecta botanica indica. 2. Gramineae quaedam, praesertim Canaranae. Verhandelingen der Eerste Klasse van het Koninklijk Nederlandsch Instituut van Wetenschappen III, 4 (1851) 30–32, reprinted as Analecta Botanica Indica 2 (1851) 30–32.
- Moulik S. 1997. The grasses and bamboos of India 1: 54–62. Scientific Publishers, Jodhpur.
- Nanakorn W, Norsangsi M. 2001. Species enumeration of Thai Gramineae: 38–39. Herbarium Queen Sirikit Botanic Garden, Chiang Mai.
- Nees CGD. 1820. Horae physicae berolinenses: 47, 54. Marcus, Bonn.
- Nees CGD. 1829. Agrostologia brasiliensis: 465. Cotta, Stuttgart, Tübingen.
- Nees CGD. 1837. Gramineae. In: Hooker WJ, Walker Arnott GA, The botany of Captain Beechey's voyage: 237. Bohn, London.
- Nees CGD. 1840. Gramineae. In: Royle JF, Illustrations of the botany ... of the Himalayan mountains: 417, 447. Allen & Co., London.
- Nees CGD. 1841. Gramineae. In: Meyen FJF, Nova Acta Physico-medica Academiae Caesareae Leopoldino-Carolinae Naturae Curiosorum 19, Suppl. 1 (preprint) 45–46.
- Nees CGD. 1843. Gramineae. In: Meyen FJF, Nova Acta Physico-medica Academiae Caesareae Leopoldino-Carolinae Naturae Curiosorum 19, Suppl. 1: 177–178.
- Nees CGD. 1850. Gramineae herbarii lindleyani. Hooker's Journal of Botany and Kew Garden Miscellany 2: 102.
- Ohwi J. 1942. The Kanehira-Hatusima 1940 collection of New Guinea plants. VI. Gramineae. Botanical Magazine, Tokyo 56: 4.
- Pfeiffer L. 1870. Synonymia botanica: 72. Fischer, Kassel.
- Phillips SM. 1995. Flora of Ethiopia and Eritrea 7: 285. Addis Ababa / Uppsala.
- Phillips SM, Chen SL. 2005. Notes on grasses (Poaceae) for the Flora of China, IV. Novon 15: 468.
- Phipps JB. 1964. Studies in the Arundinelleae (Gramineae), I. Classification of the taxa occurring in Bechuanaland, the Rhodesias and Nyasaland, and Moçambique. Kirkia 4: 87–124.
- Phipps JB. 1966a. Studies in the Arundinelleae (Gramineae). II. A new species and two new genera. Kirkia 45: 229–234.
- Phipps JB. 1966b. Studies in the Arundinelleae (Gramineae), III. Check-list and key to genera. Kirkia 5: 235–258.
- Phipps JB. 1967a. Studies in the Arundinelleae (Gramineae). V. The series of the genus Arundinella. Canadian Journal of Botany 45: 1047–1057.
- Phipps JB. 1967b. Studies in the Arundinelleae (Gramineae). VI. Development of generic concepts. Boletim da Sociedade Broteriana II, 41: 27–55.
- Phipps JB. 1968. Studies in the Arundinelleae – Four corrections. Kirkia 6: 147–148.
- Phipps JB. 1969. The genera of the Arundinelleae Stapf, Gramineae. A study in numerical taxonomy using morphological data. PhD thesis, University of Western Ontario, London, Ontario.
- Phipps JB. 1970a. Studies in the Arundinelleae (Gramineae). 10. Preliminary taximetrics. Canadian Journal of Botany 48: 2333–2356.
- Phipps JB. 1970b. Studies in the Arundinelleae (Gramineae). XI. Taximetrics of changing classifications. Canadian Journal of Botany 50: 787–802.
- Phipps JB. 1972a. Studies in the Arundinelleae (Gramineae). XII. Relationships of Arundinella, Jansenella, Trichopteryx, and the danthoniopsoids. Canadian Journal of Botany 50: 825–837.
- Phipps JB. 1972b. Studies in the Arundinelleae (Gramineae). XIII. Taximetrics of the loudetoid, tristachyoid, and danthoniopsoid groups. Canadian Journal of Botany 50: 937–948.
- Phipps JB. 1972c. Studies in the Arundinelleae (Gramineae). XIV. Taximetrics of a reduced character set. Canadian Journal of Botany 50: 1309–1336.
- Phipps JB. 1972d. Studies in the Arundinelleae (Gramineae). XVI. Danthoniopsoids – the middle way. Boletim da Sociedade Broteriana II, 46: 417–427.
- Phipps JB, Mahon JB. 1970. Studies in the Arundinelleae (Gramineae). IX. Chromosome numbers of 21 species. Canadian Journal of Botany 48: 1419–1423.
- Pilger R. 1904. Gramineae. In: Perkins JR, Fragmentae florum Philippinae: 140. Borntraeger, Leipzig, etc.
- Pilger R. 1905. Gramineae. In: Schumann K, Lauterbach CAG, Nachträge zur Flora der Deutschen Schutzgebiete in der Südsee: 56. Borntraeger, Leipzig.
- Pilger R. 1954. Das System der Gramineae. Botanische Jahrbücher für Systematik 76: 326.
- Presl C. 1829. Thysanachne, novum plantarum genus: 12, t. 6, preprint of Symbolae botanicae 1: 12, t. 6. (Oct. 1830). Spurny, Prague.
- Presl C. 1830. Reliquiae haenkeanae 1: 253. Calve, Prague.
- Raddi G. 1823. Agrostografia brasiliensis: 37. (P)reprint of Atti della Reale Accademia Lucchese di Scienze 1823: 331–383.
- Reddi VB, Phipps JB. 1972. Free amino acids as taxonomic characters in the tribe Arundinelleae (Gramineae). Brittonia 21: 403–414.
- Reichenbach HGL. 1828. Conspectus regni vegetabilis: 52. Cnobloch, Leipzig.
- Rendle AB. 1904. Gramineae. Journal of the Linnean Society, Botany, London 36: 342.
- Rhind D. 1945. The grasses of Burma: 41–42. Baptist Mission Press, Calcutta.
- Richard A. 1851. Tentamen florum abyssinicae 2: 414. Bertrand, Paris.
- Ridley HN. 1916. Report on the botany of the Wollaston Expedition to Dutch New Guinea 1912–1913. Transactions of the Linnean Society, London, Botany 9: 250.
- Roxburgh W. 1814. Hortus bengalensis: 82. Mission Press, Calcutta.
- Roxburgh W. 1820. Flora indica 1: 321. Mission Press, Serampore.
- Schmid M. 1958. Flore agrostologique de l'Indochine. L'Agronomie Tropicale 13: 462.
- Schrank F. von Paula von. 1820. Plantae rariores horti academiici monacensis: t. 58. Schrank, München.
- Schultes JA. 1824. Mantissa 2: 209. Cotta, Stuttgart.
- Schumann K. 1900. Gramineae. In: Schumann K, Lauterbach CAG, Die Flora der Deutschen Schutzgebiete in der Südsee: 174. Borntraeger, Leipzig.
- Simon BK. 1983 '1982'. New species of Gramineae from south-eastern Queensland. Austrobaileya 1: 463–464.
- Soreng RJ, Pennington SJ (eds). 2003. Catalogue of New World grasses (Poaceae): III. Subfamilies Panicoideae, Aristidoideae, Arundinoideae, and Danthoioideae. Contributions from the United States National Herbarium 46: 111–113, 628.
- Sprengel K. 1821 (Jan.). Neue Entdeckungen im ganzen Umfang der Pflanzkunde 2: 81. Fleischer, Leipzig.
- Sprengel K. 1824. Systema vegetabilium 1: 278, 287. Dieterich, Göttingen.
- Sreekumar PV, Nair VJ. 1991. Flora of Kerala – grasses: 339–341. Botanical Survey of India, Calcutta.
- Stapf O. 1898. Gramineae. Flora capensis 7: 314. Reeve & Co., London.
- Steudel EG. 1840. Nomenclator botanicus, ed. 2, 1: 21, 39, 143. Cotta, Stuttgart, Tübingen.
- Steudel EG. 1854a (Mar.). Synopsis plantarum glumacearum. Pars I. Gramineae: 114–116, 245. Metzler, Stuttgart.
- Steudel EG. 1854b (June). Gramineae. In: Zollinger H, Systematisches Verzeichniss 1: 59. Kiesling, Zürich.
- Sun B-S, Phillips SM. 2006. Arundinella. In: Wu Z, Raven PH, Flora of China 22: 563–570. Science Press, Beijing & Missouri Botanical Garden Press, St. Louis.
- Teerawatananon A. 2009. Systematics of Arundinelleae and Andropogoneae, subtribes Chionachninae, Dimerinae and Germainiinae (Poaceae: Panicoideae) in Thailand. Thesis, Trinity College, Dublin. Ined. [http://t-fern.forest.ku.ac.th/iDocument/Teerawatananon\\_PhD%20Thesis\\_2009.pdf](http://t-fern.forest.ku.ac.th/iDocument/Teerawatananon_PhD%20Thesis_2009.pdf).
- Teerawatananon A, Jacobs SWL, Hodkinson TR. 2011. Phylogenetics of Panicoideae (Poaceae) based on chloroplast and nuclear DNA sequences. Telopea 13: 115–142.
- Teerawatananon A, Sungkaew S, Hodkinson TR. 2010 '2009'. Arundinella kokutensis (Poaceae, Arundinelleae), a new species from south-eastern Thailand. Kew Bulletin 64: 747–750.
- Thunberg CP. 1784a (May–June). In: Murray JA, Systema vegetabilium, ed. 14: 113. Dieterich, Göttingen.



Thunberg CP. 1784b (Aug.). Flora japonica: 49. Müller, Leipzig.  
 Trinius CB. 1821. Agrostographische Beiträge. In: Sprengel K, Neue Entdeckungen im ganzen Umfang des Pflanzenkunde 2: 42, 81. Fleischer, Leipzig.  
 Trinius CB. 1826. De graminibus panicis. Dissertatio botanica altera: 62–63. Academia Imperialis Scientiarum, St. Petersburg.  
 Trinius CB. 1830. Species graminum iconibus et descriptionibus 3: 268, t. 265. Academia Imperialis Scientiarum, St. Petersburg.  
 Trinius CB. 1836. Graminum in hisce actis a se editorum generibus ac specibus supplementa. Mémoires de l'Académie Impériale des Sciences de St.-Petersbourg VI, 4, 2, 1: 107.

Van der Zon APM. 1992. Graminées du Cameroun. Volume II. Flore. Wageningen Agricultural University Papers 92.1: 361.  
 Veldkamp JF, Van der Have JC. 1983. The genus *Trisetum* (Gramineae) in Malasia and Taiwan. Gardens Bulletin Singapore 36: 134.  
 Webb LJ. 1954. Aluminium accumulation in the Australian-New Guinea flora. Australian Journal of Botany 2: 178.  
 Wight R. 1834. Catalogue of Indian plants: 97. London.  
 Willdenow CL. 1806. Species plantarum, ed. 4, 4: 908. Nauk, Berlin.  
 Yoshii Y, Jimbo J. 1932. Mikrochemischer Nachweis von Aluminium und sein Vorkommen im Pflanzenreiche. Science reports of the Tohoku Imperial University, Ser. 4, Biology 65: 65–77.

## INDEX TO SPECIMENS

Only the Malasian species are enumerated here.

<i>Arundinella</i>		goe	= <i>A. goeringii</i>	set	= <i>A. setosa</i>
cil	= <i>A. ciliata</i>	hol	= <i>A. holcoides</i>	(abbreviation)	= cited in the literature, not seen
fil	= <i>A. filiformis</i>	pub	= <i>A. pubescens</i>	LT, ST, T	= type material.
fur	= <i>A. furva</i>	pum	= <i>A. pumila</i>		

ANU 2165 (Flenley): fur; 5818 (Wheeler): set; 6007 (Wheeler): set – Argent & Reynoso 89127: ? fur.

Backer 1171: goe; 5186: set; 8549: goe; 10546: goe; 13936: goe; 21478: goe; 25099: set; 36014: set; 36180: (pum); 36182: goe; 37254: set; 37559: goe – Bakhuizen v.d. Brink 71a: goe; 76: goe; 404: goe; 606: goe; 3013: (goe); 3262: goe; v.d. Brink 3813: goe; 5193: goe – Balansa 16 Nov. 1886: goe; 20 Nov. 1886: goe; 20 Oct. 1886: goe – Bartlett 15532 (T): set; 8317: set; 8372: set – Beguin 16: goe – Bowers 860: fur – Brass 3563: (set); 25105: set; 25106: set; 28838: set; 29337: set; 32358: set – Bremekamp 12 July 1919: set – Brown F.H. 188 (T): set – BS 30 (Foxworthy) (LT): fil; 129: (set); 856 (Foxworthy) (T): hol; 2101 (Ramos) (ST): fil; 4244 (Mearns): set; 4271 (Merrill): set; 4328 (Merrill): hol; 4702 (Merrill): set; 5762: (set); 6238 (Merrill): set; 7399 (Merrill): hol; 12710 (Loher): hol; 13810 (Loher): fil; 14361 (Loher): (fil); 16209: (set); 19286 (Reillo): fil; 30966 (Ramos & Edaño): fil; 35453 (Martelino & Edaño): fil; 40487 (Ramos & Edaño): hol; 41268 (Ramos): set; 44756 (Ramos & Edaño): hol; 46465: (fil); 46841: (fil) – Buijsman 261: goe – Bunnemeijer 185: goe; 1252: set; 3721: set; 10847: hol; 11004: (pum); 11083: set; 11271: hol; 11718 (T): goe; 11800: (pum); 12650: hol – Buwalda 2869: goe – BW 12503 (Versteegh): set; 14013 (Sleumer & Vink): fur.

Callo & Callo s.n. 16 Oct. 1982: hol – Clason D 97: set – Clason-Laarman E 90: set – Clemens 5250: (fur); 5826-A (T): fur; 16244: (hol); 16550: (fil); 17337: (hol); 51902: (hol) – Co 3037: set – Craven 2802: fur – Cruttwell 171: set; 1623: set – Cuming 667: fil; 1415 (T): set – Curran 16154: set; 16209: set; 16212: set.

Danser 6449: goe – De Voogd 2614: (pum); 2744: set – De Wit 4204: goe; 4215: goe; 4224: goe; 4226: goe; 4235: goe.

Elbert 130: goe; 1442: pum; 5762: set; 12575: set; 17433: fil – Eyma 1203: set. Fairchild 180: set – Farinas 102: set – Feuilletau de Bruyn 107: fil.

Gibbs 5900: fur – Gillison 434-a: fur – Gjellerup 1138: fur; 1173: fur – Goering II, 139 (T): goe.

Hallier f. 2: (goe: cited by Janowski) possibly same as Hallier f. 11 Feb. 1895: goe; 4: goe; 10: goe; 17: goe – Henderson 13 July 1939: set – Hitchcock 18157: set – Höft 3060: set; 3235: set; 3276: set – Hoogland 4639: set – Hoogland & Pullen 5403: set – Hoogland & Schodde 6690: set; 7512: fur (molecular sample for Jodrell no 22524) – Hullett 16/7/1894: goe. Iboet 423: fil.

Jacobs 7389: set – Johns et al. 7955: fur; 8039: fur – Junghuhn 1880: goe. Kalkman 5208: fur – Kanehira & Hatusima 13506 (T): fur; 13569: fur – Kleinhoonte 255: set – Kneucker Gram. Exsicc. 606 (Merrill): fil; Exsicc. 802 (Merrill): hol – Kooper 921: goe – Koorders 23301: (pum); 27770: goe (cited by Janowski sub *A. fuscata*); 41005: goe; 42049: goe; 42900: set; 42912:

set; 42914: set; 43769: set – Kostermans 8 Apr. 1965: set; 18214: pum; 18833: pum – Kuntze 4432: (goe); 4805: goe – Kurz 531: goe.

LAE 57117 (Andrew): fur; 60521 (Croft & Lelean): fur; 61923 (Croft et al.): fur; 72431 (Henty): set – Lauterbach 2744 (T): set – Lobb 138: goe – Loher 1870: set; 1873: hol; 1874: fil; 1875: set; 7217: hol; 7228 (T): fil; 7234: (goe) – Lörzing 119: (goe); 475: (goe); 6467: set; 6639: set; 6665: set; 7196: set; 8594: set; 14779: set; 15465: set; 15635: set – Lörzing & Jochems 7611: set. Main 40: goe – Marsden et al. 165: fur – McDonald & Ismail 4162: set – Meijer 4545: set; 5976: set; 10363: set; 10902: hol – Meijer-Drees 145: set – Merrill Dec. 1910: hol; 39: set; 129: set; 2262 (ST): fil; 4271: set; 4702: set; Philipp. Pl. 138: set; Philipp. Pl. 161: fil; Philipp. Pl. 594: hol – Monod de Froideville 1775: fil – Mousset 19: goe (cited by Janowski, Keng).

NGF 1132 (L.S. Smith): set; 3642 (Fryar): set; 3671 (Womersley): set; 22234 (Gillison): set; 25090 (Gillison): fur.

Pajjmans 785: set – PNH 17932 (Edaño): fil; 19796 (Edaño): fil; 22973 (Steiner): set; 34763 (Steiner): set; 117516 (Gutierrez et al.): fil – Pryer A° 1900: pum – Pullen 1048: set; 2703: fur; 7800: fur; 7831: fur.

Rahmat si Boeea 6144: set – Ramlan 55: goe – Ramos 4730: set; 7931: set; 8195: set; 8210: set – Robbins 782: fur.

Santos J.V. 2095 (L.L. Co); hol; 4029: hol; 4402: set; 4936: set; 5636: set; 5749: set; 5896: set; 5898: hol; 5932: set; 5988: set; 6170: set; 6491: set; 6610: set; 6656: set; 6769: set; 6905: set; 6957: set; 7335: set; 7353: set; 7770: set; 8035: set; 8179: hol – Saunders 96: set; 97: set; 623: set; 624: set; 683: set – Schiffler 1489: goe; 1513: set; 1526: goe; 1546: goe – Schlechter 18492 ('18422'): set – Schmutz 5225: set; 5586: set; 5589: set; 5761: fil; 6063: fil – SF 650 (Haniff): set; 38440 (Agric. Officer Kelantan): set – Soekisman 52: set – Street & Manner 71: set; 107: set – Surbeck 566: set.

't Hart & Van Leeuwen H5: set – Takeuchi et al. 19654: fur – Teijsmann A° 1869: set; 8947: hol.

UPNG 315 (Gebo): set.

Van der Meer & Den Hoed 1409: goe; 1810: goe – Van der Pijl 911: set – Van Leeuwen Dj. 5a: set; TIOM 11: fur – Van Ooststroom 13100: goe; 13975: goe – Van Steenis 6001: set; 6249: set; 6574: set; 17922: hol; 18097: set; 18131: set – Vanoverbergh 318: set – Veemantri Dj. 11: set – Veldkamp 7101: set; 8913: hol; 8974: goe – Veldkamp & Stevens 5472: fur; 5545: fur – Verboom 35: set.

Walsh 56: (pum) – Warburg 1648 (T; error for 16483?): (goe); 2596: (set); 3566: (set); 16483: (goe) – White 43: set – Widjaja 4468: fur – Williams 1166: set – Willis & Utteridge 266: fur – Willis et al. 227: fur – Wisse 1077: set; 1913: goe.

Yates 891: set; 1057: set.

Zollinger 2834 (T): set.