A Revision of *Heteropholis* and *Thaumastochloa* (Gramineae)

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ABSTRACT

Heteropholis C. E. Hubb. (Gramineae, Rottboelliinae) has 4 allopatric species in Central Africa, Madagascar, Sri Lanka and from India to central Malesia. For Taiwan *H. cochinchinensis* (Lour.) Clayton var. *chenii* (Hsu) Sosef & Koning is here distinguished. The related genus *Thaumastochloa* C. E. Hubb. has 7 species mainly in Australia of which 3 are newly described here: *T. monilifera* Sosef & Koning, *T. rubra* Sosef & Koning, *T. striata* Sosef & Koning. *T. major* S. T. Blake also occurs in the Aru Islands off the south-west of New Guinea, and *T. rariflora* (F. M. Bailey) C. E. Hubb. in Papua New Guinea. A suspected hybrid between *T. major* and *T. pubescens* (Benth.) C. E. Hubb. is reported. A cladistic study indicates that the two genera may be paraphyletic.

INTRODUCTION

HISTORICAL BACKGROUND

When C. E. Hubbard (1936) described *Thaumastochloa* (Gramineae, *Rottboelliinae*) he included *T. cochinchinensis* (Lour.) C. E. Hubb. from SE. Asia and for Australia *T. brassii* C. E. Hubb., *T. pubescens* (Benth.) C. E. Hubb., *T. rariflora* (F. M. Bailey) C. E. Hubb. and an unnamed, insufficiently known species. Ohwi & Odashima (1937) included *T. shimadana* (Ohwi & Odashima) Ohwi & Odashima from Taiwan, which was soon reduced to a form of *T. cochinchinensis* by Ohwi (1942). In 1941 S. T. Blake added *T. major* S. T. Blake and *T. constricta* S. T. Blake from Australia, while Hsu (1971) proposed *T. chenii* Hsu for Taiwan.

Heteropholis as described by C. E. Hubbard (1956) originally included the African *H. sulcata* (Stapf) C. E. Hubb., the Ceylonese *H. nigrescens* (Thw.) C. E. Hubb. and an unnamed species from Madagascar, which he graciously left to Miss Camus to describe. She described it in 1956 as *H. benoistii*.

Clayton (1981) transferred *T. cochinchinensis* to *Heteropholis* and remarked that as a result *Thaumastochloa* would be restricted to Asutralia. This aroused our curiosity as Jansen in his unpublished treatment of the grasses of Malesia, Chase (1939), Reeder (1948), Henty (1969), and Lazarides (1980) had recorded at least two other species for Malesia. As the identification of these collections had turned out to be difficult, a full survey of all material became necessary, and as we were not quite satisfied about the generic delimitation of the two genera, *Heteropholis* was also completely revised.

RELATIONSHIPS OF THE GENERA

Both genera can be placed without any problem in the *Rottboelliastrae* sensu Clayton (1973), but the generic delimitation within this group and its distinction from related genera is far from clear, as was also indicated by Clayton. The use of fused versus free stipes of the pedicelled spikelets to distinguish the *Rottboelliastrae* from the *Coelorachidastrae*, respectively, makes the species with partly fused ones difficult to place, e.g. *Rottboellia coelorachis* Forst.f., *Robynsiochloa purpurascens* (Robyns) J.-Fél. of the *Rottboelliastrae* and *Coelorachis striata* (Steud.) Camus, occasionally of the *Coelorachidastrae*.

The presence of two sessile and one pedicelled spikelet per joint is supposed to be the character that distinguishes *Mnesithea* Kunth from *Coelorachis* Brongn. The expression of this feature, however, is variable even within a single inflorescence of *M. laevis* (Retz.) Kunth, the type, while on account of the presence of stipes that are at least apically fused to the rachis, the species should not have been included in the *Coelorachidastrae*. Other species sometimes regarded as belonging to *Mnesithea* often have only a few triads at the base of the inflorescence and with their free stipes are better accommodated in *Coelorachis* (Heidweiller & Van der Klaauw, MS). One collection of *T. major (q.v.)* also had such triads and fused stipes.

Several species of *Heteropholis* and *Thaumastochloa* have been included in *Ophiuros* Gaertn., which differs mainly by having the sessile spikelets in two opposing rows while the lower floret of the sessile spikelet is usually paleate and male, but may also become epaleate and sterile or paleate and female or bisexual with lodicules present whenever the sexual organs are developed (Avé, MS). In other *Rottboelliinae* the pedicelled spikelets alternate from the right hand side to the left, joint for joint, throughout the raceme.

Close to *Heteropholis* seems to be *Robynsiochloa purpurascens* of which we have seen no material. Here the lower floret of the sessile spikelet is paleate and male, while the pedicelled spikelet is well-developed, 1- or 2-flowered with the lower floret male and the upper male or sterile (apparently without lodicules). Although this species resembles especially *H. sulcata,* it is an annual and thus does not fit the transformation series thought to be represented in *Heteropholis*.

The distinction between *Heteropholis* and *Thaumastochloa* is at first rather obvious: *Heteropholis* comprises perennial plants with a persistent peduncle and completely fragmenting spikes or racemes, the species allopatrically distributed in the Afro-asian tropics, while *Thaumastochloa* contains annual plants in which the peduncle breaks off at its base and remains attached to the lowermost joint of the fragmenting spike (of course not fragmenting when only one joint is developed), the species being found more or less sympatrically in tropical Australia.

On the other hand there appears to be a gradual transition in the reduction of the various parts from West to East and we have tried to test the hypothesis that the present situation would be the result of a West-East migration with an ultimate centre of speciation in Australia from an ancestor which had become annual and had evolved this peculiar diaspore.

DIFFERENTIATING CHARACTERS FOR GENERA

When looking at the differentiating characters singly they seem not to be too impressive at the generic level.

Life form has occasionally been used to distinguish between genera, e.g. in European literature, but even for Europe this is not very satisfactory: *Avena* L. would include annual species only, but Baum (1977) grudgingly had to include one perennial, which renders a distinction against *Helictotrichon* Besser and *Avenula* (Dum.) Dum. very vague (see also Sevenster & Veldkamp, 1983). A similar situation where life form is apparently the single distinctive and thus an unsatisfactory feature is present in *Trisetum* Pers., *Koeleria* Pers. (perennials), and *Rostraria* Trin., and *Trisetaria* Forsst. (annuals) (see Veldkamp & Van der Have, 1983). On the other hand many genera are generally accepted to contain both annual and perennial species, a distinction which in the humid tropics becomes difficult to maintain anyhow. The species of *Thaumastochloa* are apparently annual, but a few collections of *T. major* have been annotated 'biennial' and 'short-lived perennial', so whatever the latter may be, doubt creeps in whether under favourable situations an extended longevity would not be possible in at least that species.

Is mode of dispersal a 'dependable' generic character? Apart from the fact that in taxonomy no ã priori value can be given to any feature, although some act as if it were otherwise, and that evaluation depends on the situation and the careful consideration of the revisor, it is frequently employed in this alliance, Clayton (1981), for instance, distinguished *Manisuris* L. from *Glyphochloa* Clayton on the mode of disarticulation of the raceme. In many cases, however, the form of the diaspore depends more on the degree of modifications of structures already present in the related taxa than on the presence of really different ones. In *Heteropholis* the lowest point of breakage in the inflorescence is below the lowest joint of the rachis, and in *Thaumastochloa* this is at the base of the peduncle, but it seems illogical to confer a separate generic status to *T. rariflora* where the articulation often takes place at the one but last vegetative node, so that the diaspore is composed of the uppermost internode and its leaf, the peduncle and the single or double joints of the rachis.

It should be obvious that distribution by itself cannot be considered as a generic character, and even its employment at the infra-specific level may not be absolute. Theoretically, disjunctions and isolation may cause distinct forms to evolve into distinct species and in the end, perhaps, genera, but in the present case the 'unit' *Thaumastochloa* fits in very well with the allopatric pattern shown by the species of *Heteropholis*. If there was but one species in Australia, how great would then be the inclination to distinguish it at generic level? The fact that there are several instead should not be an inducement to do so, tempting as it may be. Distribution should be correlated with other characters and can then at most be regarded as a confirmation of a conclusion already reached.

The correlation between life form, diaspore and distribution shown by the present two genera is of course interesting, but do three rather weak characters constitute proof when found together? At most they are very suggestive, but the alternative possibility that only a single genus with radiate speciation in Australia is involved could not be overlooked.

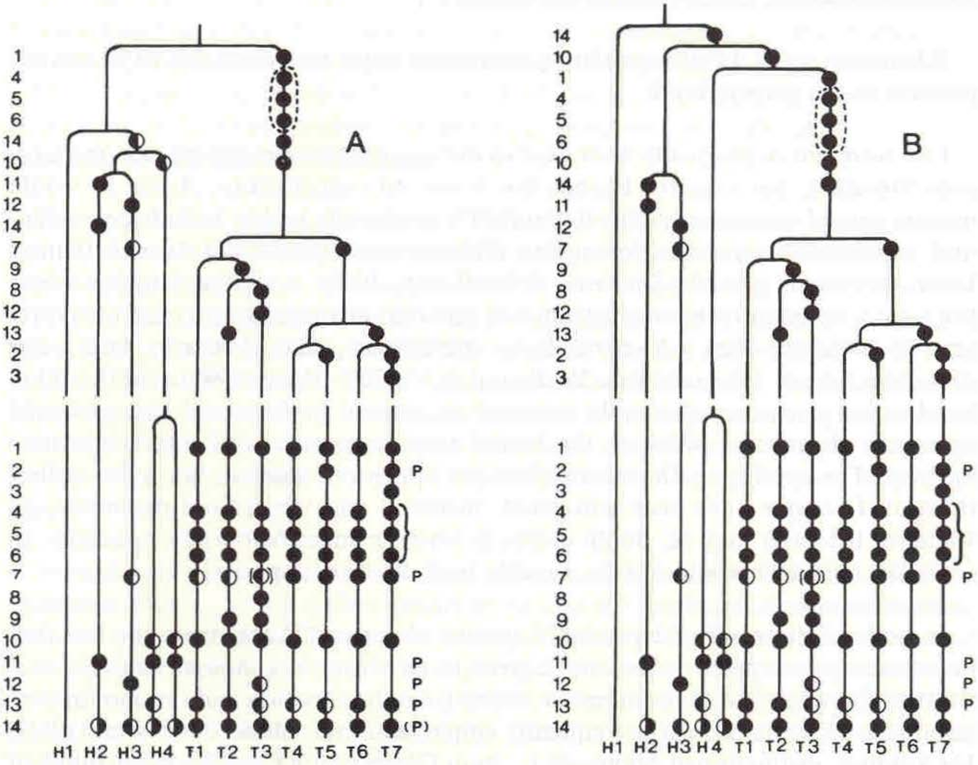

Fig. 1. Alternative models of phylogenetic relations in *Heteropholis* and *Thaumastochloa*. — ● ◐ ◑ : different apomorphous character-states. — *p*: parallel apomorphous states. — 1–10: character-states according to Table 1. — *H1-4*, *T1-7*: species of *Heteropholis* and *Thaumastochloa*. For further explanation see text.

Table 1. Survey of characters

1. Plants perennial	yes / no
2. Sheaths longer than 0.5 times the internodes	yes / no
3. Peduncle falling of with the uppermost internode and its leaf	no / yes
4. Peduncle articulating at base	no / yes
5. Peduncle adnate to the lower-most joint of the spike	no / yes
6. Peduncle smooth	yes / no
7. Number of spikelets per spike	11--more / 4--10 / 1--3
8. Spikes homomorphous	yes / no
9. Articulation of joints straight	yes / no
10. Lower glume distinctly winged	yes / narrowly / no
11. Margin of lower glume puberulous at base	yes / no
12. Nerves of lower glume	7 / 9 / 11
13. Anthers (length in mm)	2--more / 1--2 / up to 1
14. Pedicelled spikelet	male / 2 glumes only / 1 glume / 0

It is presumed that the character state on the left hand side is plesiomorphous, except for *2*, *12* and *13*, where the sequence is arbitrary.

We disagree with the views of Roberty (1960), who regarded all species of *Thaumastochloa* as subvarieties of *Rottboellia corymbosa* L.f. (now *Ophiuros exaltatus* (L.) O. Ktze) and those of *Heteropholis* as varieties of *Rottboellia myuros* (L.) Benth. (now *Manisuris myuros* L.).

A CLADISTICAL APPROACH

The use of cladistics causes one to look very carefully at the characters employed in a taxonomic study and may reveal certain erroneous preconceptions. We have employed this method in an attempt to shed some light on the present situation.

After extensive descriptions of all the taxa were made, at least fourteen characters seemed to be of some significance (Table 1) from which two alternative models could be deduced, having as few parallel apomorphies as possible (Fig. 1). In order to estimate the probable polarity of a character-state, the account of Clayton (1973) was used where numerical taxonomy was applied to the awnless genera of the *Andropogoneae.* The *Rottboelliastrae* as distinguished by him, excluding our genera, has been used as the out-group.

Characters 4, 5 and 6 should be regarded as belonging to the complex that makes an effective pseudo-awn possible and are probably best considered as a single character; they have therefore been enclosed by a broken line.

To characters 12 and 13 no polarity could be attributed, but the arbitrary choice made here does not seem to have much effect on the models.

For *T. major,* character 7 has been placed between brackets in the lower part of fig. 1 (summation of features) because of the heteromorphous spikes. Characters 3 and 8 might have been omitted because of their uniqueness for which reason the creeping habit of *H. nigrescens* was not mentioned, although these features set the various species apart.

In model A one can decide that a single genus is represented, if no generic value is accredited to the set of characters offered by 1, 4, 5, 6, 10 and 14. These divide the taxa into two groups which correspond with the two original genera. When, however, the correlation of these, perhaps minor characters is considered as evidence for a generic status, the old situation is maintained.

In model B a single genus can also be accepted, the extent of which remains uncertain; it is more easy here to envisage further steps 'upwards', whereby more taxa would be included. No infra-generic groups can formally be distinguished, however, because of the paraphyly involved, although the *Thaumastochloa*-alliance remains distinct. To do so would require the creation of three or four distinct taxa, which seems highly unsatisfactory. Nevertheless, because of one lesser partial parallelism between *Heteropholis* and *Thaumastochloa,* this model has a slight advantage. This model corresponds with a clinal variation coupled with the reduction of the pedicelled spikelet terminating in a secondary radiative speciation in Australia, which was the alternative explanation outlined above before the cladistics were done. It should be noted that in neither model there is a complete correlation with the geography: the pedicelled spikelet is more reduced in *H. benoistii* from Madagascar than in *H. nigrescens* from Sri Lanka.

To make an educated guess as to which model should have preference, the outgroup must be known in more detail. Only then a good insight can be obtained of the evolutionary tendencies within it. At present it seems therefore irresponsable to choose in favour of either model with any certainty. Hence, for the present, matters are better left as they were, and so we have kept the genera distinct.

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KEY TO THE GENERA

1. Perennials. Peduncle smooth, not articulating at base. All joints of the spike articulating in fruit. Central Africa to Micronesia, not in New Guinea. .... *Heteropholis*

1. Annuals. Peduncle scabrous, articulating at base or with the uppermost internode and its leaf. Lowermost (or the only) joint of the spike persistent in fruit. Australia, New Guinea. .... *Thaumastochloa*

HETEROPHOLIS

Heteropholis C. E. Hubb. in Hook., Ic. Pl. 36 (1956) t. 3548; Camus, Bull. Soc. Bot., France 103 (1956) 475; Clayton, Kew Bull. 35 (1981) 816. — *Type: H. sulcata* (Stapf) C. E. Hubb.

Perennials, branching intra-and/or extra-vaginally at base. Ligules collar-shaped, membranous, margin ciliolate. Peduncle glabrous, smooth, not articulating at base. Spikes ± terete, dehiscing transversally into swollen joints, which bear a sessile spikelet and a more or less reduced pedicelled one, with a 'knob' at base (remnants of the vasculature). Spikelets unilaterally in 1 or 2 slightly alternating rows, unawned. Sessile spikelets sunken into the joints, with 2 florets, the lower one reduced to a lemma, the upper one bisexual. Callus short, glabrous. Lower glume slightly convex, indurated, 5–11-nerved, smooth or with longitudinal rows of small pits between the nerved or rugose, 2-keeled, glabrous or margins at base puberulous, margins narrow, stiff, infolded, apex more or less winged, acutish. Upper glume boatshaped, slightly keeled, 3–7-nerved, scarious to membranous. Lemmas and paleas obtuse, scarious to slightly membranous. First lemma 2-nerved. Second lemma 0–3-nerved. First palea absent, second palea present, 0- or 2-nerved. Lodicules pre-

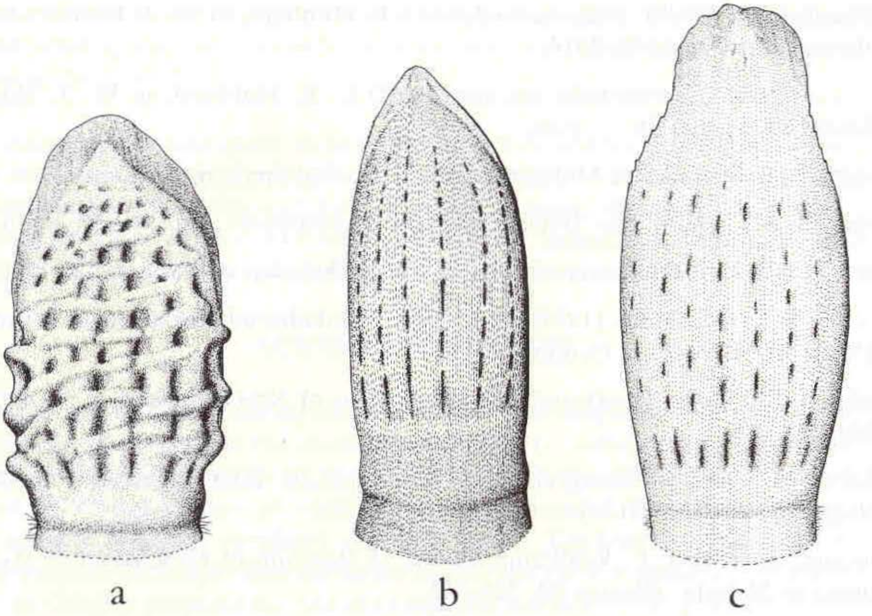
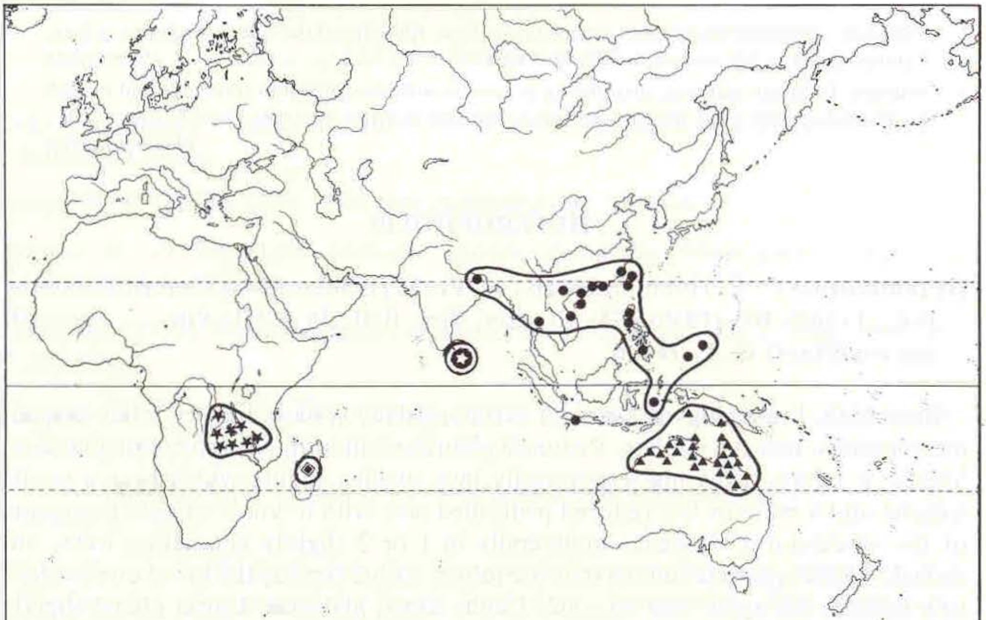


Fig. 2. Sessile spikelets of *Heteropholis*. — *a. H. sulcata (Quarré 137); b. H. benoistii (Bosser 15241); c. H. nigrescens (Davidse & Sumithraarachchi 7961).* × 15.



Map 1. Solid stars: *Heteropholis sulcata;* diamond: *H. benoistii;* open star: *H. nigrescens;* circles: *H. cochinchinensis, s.l.;* triangles: *Thaumastochloa* spp.

sent in the upper floret, broad- to oblong-cuneate, truncate, glabrous. Anthers 3, purple. Styles 2, free; stigmas purple. Caryopsis ovoid to broadly ellipsoid, dorsally flattened; hilum (sub-)basal, punctiform; embryo 0.5–0.8 times as long as the caryopsis. Stipe of the pedicelled spikelet partly to entirely adnate to the joint. Pedicelled spikelet much reduced to absent, 1-flowered, male or neuter. Glumes, when well-developed, herbaceous to indurated, the lower one keeled, 5-9-nerved, not sculptured, the upper one boat-shaped, sometimes with an infolded margin, 3–5-nerved. Lemma and palea much reduced. Lodicules present or not. Anthers 0 or 3.

Distribution. Four species allopatric in E. Africa, Madagascar, Sri Lanka, or from SE. Asia to S. China, E. Malesia and Micronesia.

Ecology. Savannahs, dry grasslands, forest edges, up to 1800 m alt.

Chromosome numbers. N = 18 [*H. cochinchinensis* (Lour.) Clayton var. *cochinchinensis, H. nigrescens* (Thw.) C. E. Hubb.].

Note. Hubbard described the sessile spikelets as 2-flowered with the lower floret being male or sterile and with a palea equal to the lemma or shorter to absent. Hsu (1971) also described and depicted a first palea for *H. cochinchinensis* (Lour.) Clayton (*q.v.*). However, in all specimens seen by us this floret was always reduced to an empty lemma.

KEY

1. Pedicelled spikelets absent. SE. Asia. 2
1. Pedicelled spikelets more or less developed. Africa, Madagascar, Sri Lanka. 3
2. Sessile spikelets 2.7–4 mm long. Lower glume narrowly winged. Anthers 1.5–1.7 mm long. .... *4a. H. cochinchinensis* var. *cochinchinensis*
2. Sessile spikelets 4–4.5 mm long. Lower glume distinctly winged at the apex. Anthers ± 2.8 mm long. Taiwan. .... *4b. H. cochinchinensis* var. *chenii*
3. Blades 4–10 mm wide, at least the margins pubescent. Pedicelled spikelets 4–5 mm long. ... 4
3. Blades 1.5–2 mm wide, glabrous. Pedicelled spikelets 2–3 mm long. Madagascar. .... *2. H. benoistii*
4. Blades up to 12 cm long. Spike 6–10-jointed. Lower glume of the sessile spikelet with small pits. Pedicelled spikelet neuter. Sri Lanka. .... *3. H. nigrescens*
4. Blades up to 60 cm long. Spike 20–30-jointed. Lower glume of the sessile spikelet areolate. Pedicelled spikelet male. Central E. Africa. .... *1. H. sulcata*

1. **Heteropholis sulcata** (Stapf) C. E. Hubb. — Map 1, fig. 2a

Heteropholis sulcata (Stapf) C. E. Hubb. in Hook., Ic. Pl. 36 (1956) t. 3548, p. 2; J.-Félix, Gram. Afr. Trop. 1 (1962) 282, f. 218; Clayton & Renvoize, Fl. Trop. E. Afr., Gram. 3 (1982) 849. — *Peltophorus sulcatus* Stapf, Fl. Trop. Afr. 9 (1917) 59, *comb. ill.;* Robijns, Fl. Agrost. Congo Belge 1 (1929) 63. — *Manisurus sulcata* Dandy, J. Bot. 69 (1931) 54. — *Rottboellia myuros* (L.) Benth. var. *sulcata* Roberty, Mon. Androp. (1960) 82. — *Type: Homblé 56* (K, holo; BR), Zaire, Katanga, Lubumbashi (Elisabethville), February 1912.

Culms 60–150 cm high. Nodes 3–5, glabrous, rarely hairy. Sheaths 8–12 cm long, 0.4–0.75 times as long as the internodes, subglabrous to hirsute. Blades linear, flat to involute, up to 60 cm by 4–10 mm, subglabrous to hirsute. Peduncle 12–25 cm long. Joints 20–30. Sessile spikelets slightly alternating, 3.5–5 mm long. Lower glume 5–9-nerved, areolate because of longitudinal and transverse ribs, margins puberulous at base, apex winged, acuminate. Anthers 2.4–2.5 mm long. Pedicelled spikelet more or less well-developed; stipe adnate in the lower half to completely so with the joint and approximately as long as the joint; spikelet 4–5 mm long, male, lodicules present.

Distribution. Zaire (Katanga: Bianos, Kalule, Kienge, Kivilolo, Kundelungu Plateau, Lubumbashi, Manika Plateau, Musoka-Tanda, Tumbwe), Zambia (Abercorn, Chishinga, Lundazi, Ndola, Solwezi), Malawi (Mzimba, Mzuzi), Tanzania (Songea).

Ecology. Open woodland dominated by *Brachystegia* (e.g. *B. boehmii, B. floribunda, B. microphylla*) and with *Andropogon schirenzis, Isoberlinia* sp., 900–1830 m alt.

Collector's notes. Loosely tufted, to 1.5 m high. Rhizome creeping, roots brown, wiry. Lower sheaths reddish purple. Culms bright green. Leaves erect, apex ± pendulous. Sessile spikelets yellowish green. Pedicelled spikelets pale green with dark green nerves. Anthers, stigmas dark purple. Entire plant turning black. (Mainly after Milne-Redhead & Taylor 9058, BR).

Vernacular name. Kipolo (Katanga: Kibemba).

Note. The plants are nigrescent with a greyish hue when dried, as was also noticed in the field.

2. Heteropholis benoistii Camus — Map 1, fig. 2b

Heteropholis benoistii Camus, Bull. Soc. Bot., France 103 (1956) 476. — *Type: Benoist 1639* (P, holo), Madagascar, Domaine Central, Manjakatompo, Ankaratra, 1700 m alt., 20 December 1951.

Culms 35–50 cm high. Nodes 6–more, glabrous. Sheaths up to 7 cm long, shorter than the internodes, margins distally pilose, otherwise glabrous. Blades linear, flat to involute, up to 25 cm by 1.5–2 mm. Peduncle up to 13 cm long. Joints 12–more. Sessile spikelets slightly alternating, 3–4.35 mm long. Lower glume 5–7-nerved, with rows of small pits, margins glabrous at base, apex minutely winged, acuminate. Anthers ± 2.1 mm long. Pedicelled spikelets reduced, to the lower glume; stipe adnate with and ± 0.8 times as long as the joint; spikelet 2–3 mm long.

Distribution. Madagascar (Domaine Central).

Ecology. Savannahs, up to 1700 m alt.

Note. Only two collections seen (*Benoist 1639, Bosser 15241,* P).

3. Heteropholis nigrescens (Thw.) C. E. Hubb. — Map 1, fig. 2c

Heteropholis nigrescens (Thw.) C. E. Hubb. in Hook., Ic. Pl. 36 (1956) t. 3548, p. 4; Bor, Grasses (1960) 162. — *Rottboellia nigrescens* Thw., Enum. Pl. Zeyl. (1864) 364; Hack., Mon. Androp. (1889) 296; Hook. f., Fl. Br. Ind. 7 (1896) 157; Hook. in Trimen, Handb. Fl. Ceyl. 5 (1900) 207; Senaratna, Gr. Ceylon (1956) 180; Gould & Soderstrom, Can. J. Bot. 52 (1974) 1085, 1088, f. 71. — *Manisurus nigrescens* O. Ktze, Rev. Gen. Pl. 2 (1891) 780. — *Rottboellia myuros* (L.) Benth. var. *nigrescens* Roberty, Mon. Androp. (1960) 81. — *Type: Thwaites CP 867* (PDA, holo, K. *n.v.*; BM, BO, SING), Ceylon, Central Prov., Bagavantalawa, 1220 m alt.

Culms up to 60 cm high. Nodes 10–15, glabrous. Sheaths 3–6 cm long, 0.45–0.75 times as long as the internodes, pilose along the margins, otherwise subglabrous. Blades linear, flat, up to 12 cm by 6–11 mm, margins hairy at base, otherwise glabrous. Peduncle up to 5 cm long. Joints 6–10. Sessile spikelets ± in 1 row, ± 4.5 mm long. Lower glume 11-nerved, with rows of small pits, margins puberulous at base, apex narrowly winged, acute. Anthers ± 2 mm long. Pedicelled spikelet reduced to the glumes; stipe entirely adnate to and ± 0.67 times as long as the joint; spikelet up to 4 mm long.

Distribution. Sri Lanka: Central and Trincomalee Prov.

Ecology. Cracks of cliffs, forest edges, 1200–1560 m alt.

Chromosome number. 2n = 36 (Gould & Soderstrom, 1974; '60' *sphalm.* p. 1088).

Collector's notes. Plants scandent, base long-decumbent, rooting at the nodes.

Note. Plants nigrescent.

4. Heteropholis cochinchinensis (Lour.) Clayton — Map 1.

a. var. **cochinchinensis.** — Fig. 3a

Heteropholis cochinchinensis (Lour.) Clayton, Kew Bull. 35 (1981) 816. — *Phleum cochinchinense* Lour., Fl. Cochinch. (1790) 48. — *Paspalum ? cochinchinense* R. & S., Syst. Veg. 2 (1817) 317. — *Ophiuros cochinchinensis* Merr., Trans. Am. Philos. Soc., n.s. 24, 2 (1935) 72. — *Thaumastochloa cochinchinensis* C. E. Hubb. in Hook., Ic. Pl. 34 (1936) t. 3313, 3314, p. 2; Ohwi, Bot. Mag., Tokyo 55 (1941) 551; Raizada *et al.*, Ind. For. Rec., n.s. 4 (1957) 211; Bor, Grasses (1960) 247; Dansk Bot. Ark. 23 (1965) 165; Koyama in Walker, Fl. Okinawa (1976) 238; Anon., Ic. Corm. Sin. 5 (1976) 195, t. 7219. — *Rottboellia corymbosa* L.f. subvar. *cochinchinensis* Roberty, Mon. Androp. (1960) 65. — *Thaumastochloa cochinchinensis* forma *cochinchinensis:* Hsu, Taiwania 16 (1971) 335, f. 2a; Fl. Taiwan 5 (1978) 701, f. 1481. — *Type: Hb. Loureiro* (BM, holo, *n.v.*), Cochinchina.

Ophiuros monostachyus Presl, Rel. Haenk. 1 (1830) 330; Miq., Fl. Ind. Bat. 3 (1857) 405; Hack., Mon. Androp. (1889) 318; Camus, Fl. Gén. I.-C. 7 (1922) 373, f. 38; Merr., Enum. Philip. Fl. Pl. 1 (1925) 41. — *Rottboellia monostachya* Schmid, l'Agron. Trop. 13 (1958) 193, *nom. inval.* — *Type: Haenke s.n.* (PR, holo, *n.v.*), Philippines, Luzon.

Ophiuros undatus Nees in Hook., J. Bot. Kew 2 (1850) 100; Steud., Syn. 1 (1854) 360 ('*undulatus*'); Miq., Fl. Ind. Bat. 3 (1857) 405 (id.); Benth., J. Linn. Soc., London, Bot. 19 (1881) 69 (id.). — *Type: Cuming 1339* (BM, L, P, W; K, *n.v.*).

Ophiuros shimadanus Ohwi & Odashima, Acta Phytotax. & Geobot. 5 (1936) 185. — *Thaumastochloa shimadana* Ohwi & Odashima, Acta Phytotax. & Geobot. 6 (1937) 151. — *Thaumastochloa cochinchinensis* C. E. Hubb. forma *shimadana* Ohwi, Acta Phytotax. & Geobot. 11 (1942) 178; Hsu, Taiwania 16 (1971) 335; Taiwan Gr. (1975) 779, f. 285; Fl. Taiwan 5 (1978) 701. — *Type: Shimada 4852* (KYO, holo, *n.v.*), Taiwan, Hsinchu.

Thaumastochloa chenii auct. non Hsu: Hsu, Taiwania 16 (1971) 335, *pro Chen 123.*

Thaumastochloa cochinchinensis auct. non C. E. Hubb.: Chen & Hsu, J. Jap. Bot. 37 (1962) 306, 313, f. 28, 29, *pro Chen 123.*

Culms up to 60 cm high. Nodes 3–4, glabrous. Sheaths 3–6 cm long, 0.25–0.75 time the length of the internodes, margins at the top with the long hairs, otherwise glabrous. Blades linear, flat to involute, up to 45 cm by 2–5 mm, margins at base with long hairs, otherwise (sub-)glabrous. Peduncle up to 10 cm long. Joints 12-more. Sessile spikelets ± in 1 row, 2.7–4(–4.5) mm long. Lower glume 7-nerved, smooth to minutely pitted in longitudinal rows, margins glabrous at base, apex narrowly winged, obtuse to acute. Anthers 1.5–1.75 mm long. Pedicelled spikelet reduced to a small scale; stipe entirely adnate to and ± as long as the joint.

Distribution. India (e.g. Uttar Pradesh, Bihar, no doubt elsewhere), Thailand (Northern: Sukhotai, Nakhon Sawan; Southwestern: Ratchaburi), Vietnam (Tu Phap, Huē, Hanoi, Phocam), China (Canton, Hainan, Hong Kong, Putien), Taiwan, Ryu Kyu Isl. (Iriomote, Okinawa), *Malesia*: Java (Banjumas), Lesser Sunda Isl. (Bali, *fide* Jansen MS), Philippines (Luzon, Mindanao), Moluccas (Buru), Carolines (Palau, Yap), Marianes (*fide* C. E. Hubbard).

Ecology. Savannahs, disturbed places, e.g. roadsides, bunds of rice fields, in rice fields, grass fields, up to 600 m alt.

Collectors' notes. Very few: caespitose.

Chromosome numbers. N = 18 (Chen & Hsu, 1962, at least *pro Chen 123,* TAI).

Notes. The only record for Java (not mentioned in the *Flora of Java!, Kievits 1543,* L) probably constitutes an introduction. It has relatively large lower glumes and anthers. Jansen (MS) mentioned an unnamed collection present in BO, purported from Bali but Veldkamp could not find any trace of it there. The record for the

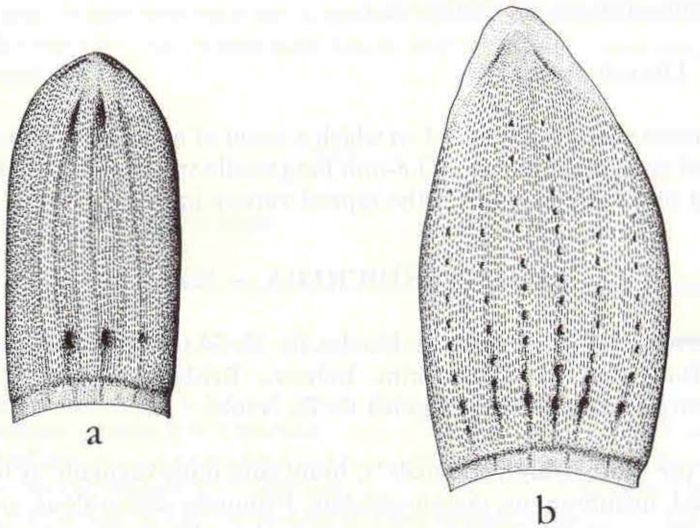


Fig. 3. Sessile spikelets of *Heteropholis* cont. — *a. H. cochinchinensis* var. *cochinchinensis* (Merrill 9875); *b. H. cochinchinensis* var. *chenii (Hsu 511, type).* × 15.

Marianas could not be verified with the loan from K.

Although the types of '*cochinchinensis*', '*monostachyus*' and '*shimadanus*' have not been seen, there is enough evidence from the descriptions, later remarks and subsequent material for the authors to be certain of their identities. The last epithet was employed by several authors for specimens with pitted lower glumes, but some collections (e.g. *Balansa 503,* L; *Chuang 1560, Hsu & Kuoh 13658A, Suzuki s.n., Tanaka & Shimada,* TAI, etc.) were seen to have both pitted and smooth lower glumes even within the same inflorescence, from which we conclude that this character has no great taxonomic significance. However, specimens with both pitted lower glumes and distinctly larger spikelets and anthers have been tentatively kept distinct by us as the next variety.

Hsu (1971) described, compared and even depicted lower paleas for both varieties, but in all the materal seen by us, also that from TAI, we have not even encountered a trace of them.

b. var. **chenii** (Hsu) Sosef & de Koning, **stat. & comb. nov.** — Fig. 3b

Thaumastochloa chenii Hsu, Taiwania 16 (1971) 216, 335, f. 2; Taiwan Gr. (1975) 777, f. 284; Fl. Taiwan 5 (1978) 700. — *Type: Hsu 511* (TAI, holo; TI), Taiwan, Pingtung Co., O-luan-pi, ± at sea level, 21 September 1959.

Differs from var. *cochinchinensis* by the lower glumes of sessile spikelets being (3.5-)4-4.5 mm long, apex somewhat more broadly winged, always with pits in longitudinal rows, and especially by the ± 2.8-mm long anthers.

Distribution. Taiwan (Pingtung Co.).

Ecology. Littoral grasslands.

Chromosome number. Chen 123 on which a count of n = 18 was based and which was included in this taxon, has ± 3.8-mm long sessile spikelets and ± 1.7 mm-long anthers and obviously belongs to the typical variety (*q.v.*).

THAUMASTOCHLOA — Map 1

THAUMASTOCHLOA C. E. Hubb. in Hook., Ic. Pl. 34 (1936) t. 3313, 3314; Simon, Techn. Bull. Bot. Br. Dept. Prim. Industr., Brisbane 3 (1978) 13. — *Type: Thaumastochloa pubescens* (Benth.) C. E. Hubb.

Annuals (or short-living perennials?), branching intra-vaginally at base. Ligules collar-shaped, membranous, margin ciliolate. Peduncles scaberulous, articulating at base or breaking off with the uppermost internode and its leaf, gradually narrowing to base, at least in the lower third. Spikes ± terete, the lower joint (or the only one) ± persistently adnate to the peduncle, the others (if any) dehiscing transversely to obliquely into swollen to inflated joints which bear a sessile spikelet and the remnant of a pedicelled one, with a 'knob' at base (remnants of the vascularity). Spikelets unilaterally in 1 or 2 somewhat alternating rows, unawned. Sessile spikelets sunken into the joints, with 2 florets, the lower one reduced to a lemma, the upper one bisexual. Callus short, glabrous. Lower glume convex to slightly concave, indurated, 7–9-nerved, smooth or variously longitudinally and/or transversely sculptured, 2-keeled, margins at base puberulous, otherwise usually glabrous, margins narrow, stiff infolded, apex somewhat acute, unwinged. Upper glume convex, slightly keeled, 3–5-nerved, scarious to slightly indurated. Lemmas and paleas obtuse, scarious. First lemma 2-nerved, second one 0–3-nerved. First palea absent, second one present, 0-nerved. Lodicules present in the upper floret, cuneate, truncate, glabrous. Anthers 3, purple. Styles 2, free; stigmas purple. Caryopsis broadly ovoid, dorsally flattened; hilum sub-basal, punctiform; embryo 0.5–0.67 times as long as the caryopsis. Stipe of the pedicelled spikelet adnate to the joint; spikelet absent or reduced to a miniscule scale.

Distribution. Seven species (and a possible hybrid) more or less sympatric in Northern Australia (W. Australia, N. Territory, Queensland) and *Malesia* (Aru Isls, New Guinea, each with 1 sp.).

Ecology. Savannahs, sandy places, up to 1000 m alt.

Notes. The spikes of most species are homomorphous, but in *T. major* S. T. Blake two different types may be present even on the same plant: long ones with 4–10 relatively broad joints, and short ones with 1–3(–4) relatively narrow joints.

As these plants grow in often nearly inaccessible places and may not be evident because of their annual life cycle, a wider distribution, certainly in Malesia, may be expected with increase of the variability as more material is acquired, while undescribed species may well turn up. Compare for instance the supposedly monotypic genus *Micraira* F.v.M., which now has at least 8 species (Lazarides, Brunonia 2, 1979, 67–84)!

KEY

1. At least some spikes with 4–more joints 2

1. All spikes with 1–3 joints 5

2. All joints 1–1.8 mm across — Lower glumes areolate to weakly rugulose, at least in some spikes 3

2. At least some joints 2–3.5 mm across — Lower glumes usually smooth to at most weakly rugulose 4

3. Spikes homomorphous, joints 4–9. Lower glumes all weakly rugulose to areolate, but the basal sometimes smooth. Anthers 0.75–1 mm long .... *1. T. pubescens*

3. Spikes heteromorphous, some 4–9-jointed and lower glumes areolate, others 1–3-jointed and lower glumes smooth. Anthers ± 1.1 mm long .... *? T. major* x *pubescens*

4. Culms up to 70 cm high. Spikes homomorphous. Joints inflated. Anthers 0.5–1 mm long .... *2. T. monilifera*

4. Culms up to 35 cm long. Spikes homo- or heteromorphous. Joints cylindric. Anthers 1.4–1.7 mm long .... *3. T. major*

5. Lower glume smooth 6

5. Lower glume longitudinally grooved or transversely rugose 7

6. Well-developed sheaths 0.17–0.33 time length of internode. Peduncle 0.5–3 cm long, usually falling off with the uppermost internode. Joints 2.5–3 mm long .... *7. T. rariflora*

6. Well-developed sheaths 0.5–>length of internodes. Peduncle 1.5–18 cm long, articulating at base. Joints 3–6 mm long .... *3. T. major*

7. Culm-nodes 4–8. Lower glume longitudinally grooved. Anthers 1.1–1.7 mm long 8

7. Culm-nodes 10–15. Lower glume transversely rugose. Anthers 0.6–0.7 mm long *6. T. brassii*

8. Well-developed sheaths 0.17–0.33 time length of internode. Peduncle 0.5–2 cm long, glabrous .... *5. T. rubra*

8. Well-developed sheaths 0.5–same length as internode. Peduncle 4–18 cm long, with rows of minute hairs (20x!) in the upper third .... *4. T. striata*

1. **Thaumastochloa pubescens** (Benth.) C. E. Hubb. — Map 2, fig. 4

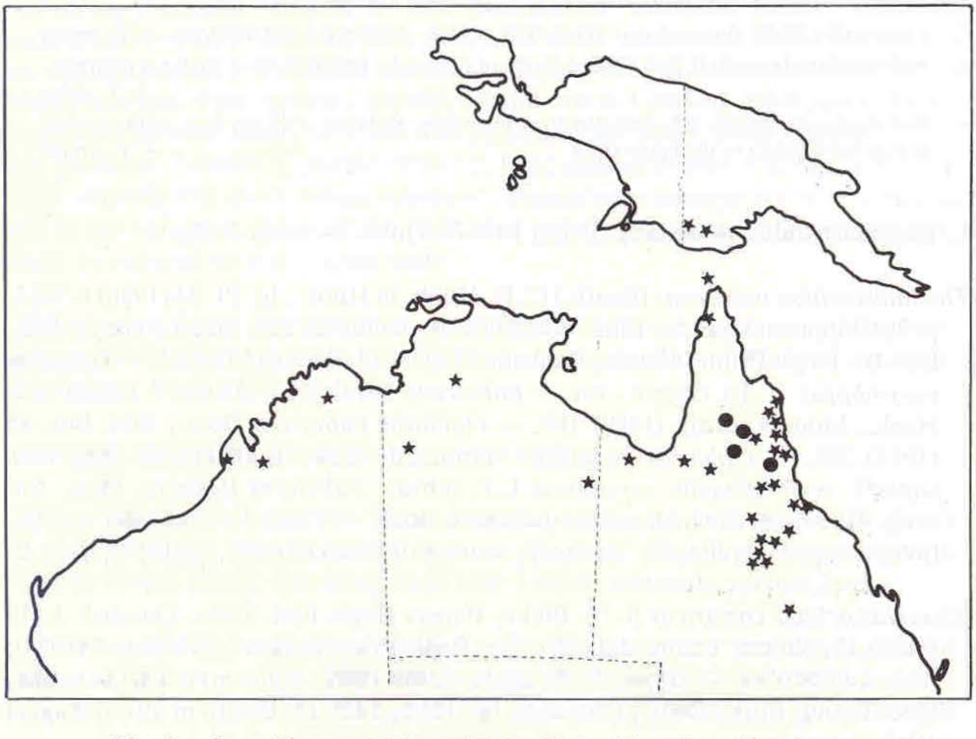
Thaumastochloa pubescens (Benth.) C. E. Hubb. in Hook., Ic. Pl. 34 (1936) t. 3313, p. 2; Chippendale, Proc. Linn. Soc. N. S. W. 96 (1972) 223; Simon, Techn. Bull. Bot. Br. Dept. Prim. Industr., Brisbane 3 (1978) 13; ibid. 4 (1980) 84. — *Ophiuros corymbosus* (L.f.) Gaertn. var. ? *pubescens* Benth., Fl. Austr. 7 (1878) 512; Hack., Mon. Androp. (1889) 318. — *Ophiuros pubescens* Dom., Bibl. Bot. 85 (1915) 262. — *Ophiuros pollockii* Marquand, Kew. Bull. (1925) 284, *nom. superfl.* — *Rottboellia corymbosa* L.f. subvar. *pubescens* Roberty, Mon. Androp. (1960) 66, *excl. Mnesithea pubescens* Ridl. — *Type: F. v. Mueller s.n.* (K, holo, *n.v.*), Australia, N. Territory, sources of Hooker's Cr., ± 18° S, 130° E.

Thaumastochloa constricta S. T. Blake, Papers Dept. Biol. Univ. Queensl. 1, 18 (1941) 19; Simon, Techn. Bull. Bot. Br. Dept. Prim. Industr., Brisbane 3 (1978); ibid. 4 (1980) 84. — *Type: S. T. Blake 12460* (BRI, holo, *n.v.*; L), Australia, Queensland, Burke Distr., Croydon, 18° 12' S, 142° 15' E, 110 m alt., 8 August 1936.

Ophiuros corymbosus auct. non Gaertn.: R. Br., Prodr. (1810) 207.

Culms 12–30 cm high, rarely more. Nodes 5–9. Sheaths 1–3 cm long, 0.5–same length as internode, pilose. Blades linear, flat, 2–9 cm by 1.5–4 mm, pilose. Peduncle erect, ± straight, gradually narrowed towards the base where it articulates, up to 10 cm long, glabrous. Spikes homomorphous, cylindric to constricted, 1.5–3.5 cm by 1–1.8 mm across. Joints 4–9, articulation straight to oblique, 3–4 mm long, glabrous, rarely puberulous. Spikelets somewhat alternatingly in 2 rows, 2–3 mm long. Lower glume ovate-oblong, flat to convex, the lowermost usually smooth, the others weakly transversely rugulose to areolate by longitudinal and transverse ribs, 7–9-nerved. Upper lemma 2-nerved. Anthers 0.75–1 mm long.

Fig. 4. Sessile spikelets of *Thaumastochloa — T. pubescens (McKee 9183).* × 15.



Map 2. Stars: *Thaumastochloa pubescens;* circles: *T. major* × *T. pubescens.*

Distribution. Malesia: New Guinea (Western Distr.: Arufi, Rouku); Australia: W. Australia (N. of Broome, Karunjie St., Kimberley Res. St.), N. Territory (Hooker's Cr., Katherine, Mittibah St.), Queensland (Atherton, Batavia, Burra, Campaspe R., Cheltenham, Conjuboy St., Cooktown, Croydon, Doomagee, Endeavour R., W. of Ingham, Jericho, Lizard Isl., Mungana, Mareeba, Normaton, Pentland, Poison Cr., Port Douglas, Torrens Cr., Townsville, Yarromeere).

Ecology. Low lying, damp sandy places, gullies, exposed coastal sand dunes, weedy in fields and disturbed places, open savannah forests with e.g. *Acacia cowleana, Erythrophloeum* sp., *Eucalyptus calleni, E. dichromophloia, E. miniata, E. polycarpa, Grevillea glauca, Petalostigma* sp., *Spinifex* sp., *Triodia pungens,* up to 840 m alt.

Collector's notes. Tufted, culms prostrate to erect, up to 30 cm high or radiating to 1.5 m in diam., subglaucous, dull green, brown, or reddish. Racemes green, spikelets paler to purplish.

Notes. Although Hubbard and many others cited Domin as the author of the basionym, it should be Bentham. The presence of a question mark does not invalidate the latter's publication (Art. 34.2).

Roberty included *Mnesithea pubescens* Ridl. in his synonymy, but that species has little to do with the present genus; the correct name for it is *Coelorachis mollicoma* (Hance) Bor (Heidweiler & Van der Klaauw, MS).

S. T. Blake distinguished *T. constricta* because of its puberulous and constricted joints. As several intermediate collections were available these distinctions could not be upheld.

Four collections (*S. T. Blake 13604, 13738, Clarkson 3146, Symon 4883* from Queensland, BRI) possess heteromorphic spikes, with one type similar to those of *T. pubescens* and the other to the small form found in *T. major*. The anthers are 1.1 mm long. These collections may be of hybrid origin (*T. major x T. pubescens*), or represent an infraspecific taxon (but of which species?), or belong to a distinct species altogether (see Map 2). At present we cannot offer a satisfactory solution.

On the other hand there are mixed collections of both species, which may confuse those unaware of the heteromorphy of the spikes of *T. major,* e.g. *Bailey s.n.* (K) from Thursday Isl., which led Hubbard to observe that it might represent 'probably a new species related to *T. pubescens.*'.

2. Thaumastochloa monilifera Sosef & Koning, **sp. nov.** — Map 4, fig. 5a

Thaumastochloa sp.: Simon, Techn. Bull. Bot. Br. Dept. Prim. Industr., Brisbane 3 (1978) 13; ibid. 4 (1980) 84, *pro Symon* 4795.

Culmi ad 70 cm alti. Spicae homomorphicae, articulis 4–8 inflatis 2–3.5 mm in diam. Glumae inferiores modice rugulosae. Antherae 0.5–1 mm longae. — *Type: Brass 19712* (L, holo; A), Australia, Queensland, Cook Distr., Wenlock R., 12° 11' S, 141° 53' E, 150 m alt., 27 July 1948.

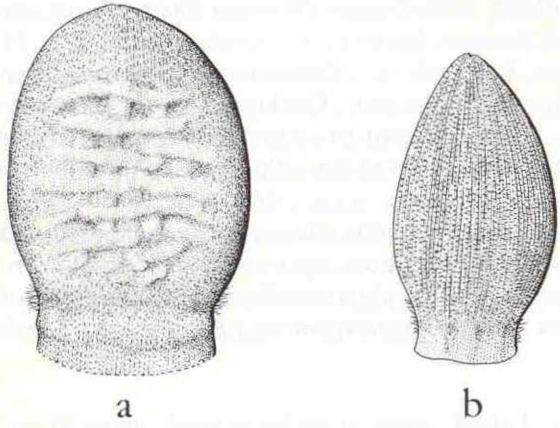


Fig. 5. Sessile spikelets of *Thaumastochloa* cont. — *a. T. monilifera (Latz 1509); b. T. major (Collins 377).* × 15.

Culms up to 70 cm high. Nodes 5–9. Sheaths 2.5–4 cm long, 0.33–0.68 times as long as the internodes, pilose. Blades linear, flat, 4–11 cm by 2–5 mm, pilose. Peduncle ± erect, straight, gradually narrowed towards the base, where it articulates, 1–8 cm long, glabrous. Spikes homomorphous, moniliform, 1–1.5 cm by 2–3.5 mm across. Joints 4–8, articulation oblique, 1.7–5 mm long, glabrous. Spikelets alternatingly in 2 rows, 1.6–3.5 mm long. Lower glume triangular-ovate, slightly convex, weakly rugulose, 7-nerved. Upper lemma not nerved. Anthers 0.5–1 mm long.

Distribution. Australia: Queensland (Batavia, Bing Bong, Koolburra, Laura, S. of N. Kennedy R., Wenlock R.).

Ecology. Dry sandy banks of gullies, road-sides, savannah forest with e.g. *Acacia* sp., *Eucalyptus tetrodonta, Melaleuca* sp., *Callitris intratropica*-heath.

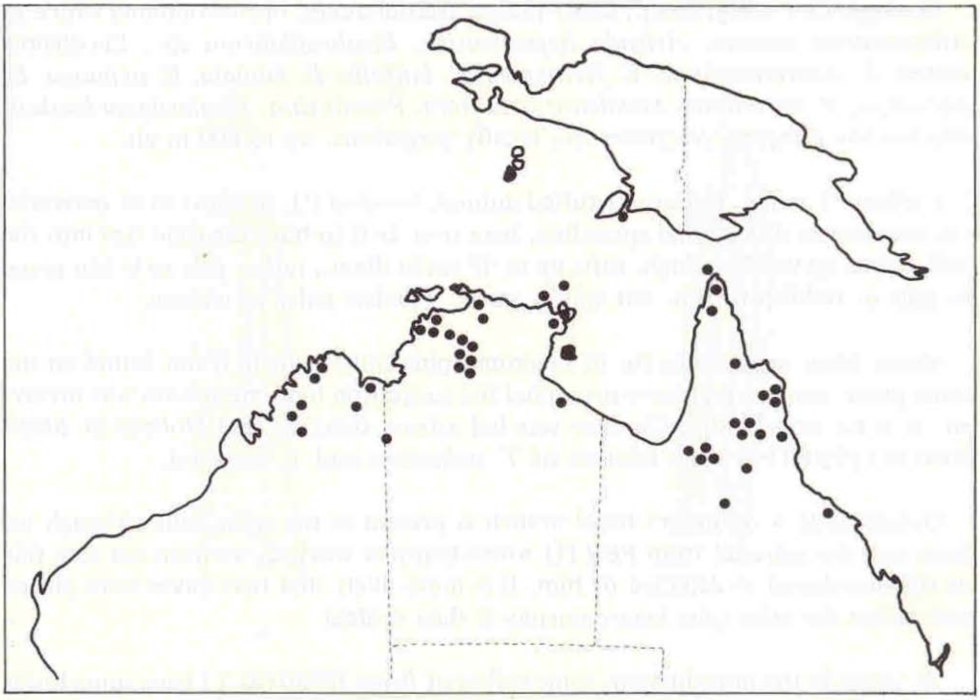
Collector's notes. Plants semi-prostrate, culms weak, 40-60 cm long.

Note. Named for the bead-like joints of the spike.

3. **Thaumastochloa major** S. T. Blake — Map 3, fig. 5b

Thaumastochloa major S. T. Blake, Papers Dept. Biol. Univ. Queensl. 1, 18 (1941) 20; Chippendale, Proc. Linn. Soc. N. S. W. 96 (1972) 223; Simon, Techn. Bull. Bot. Br. Dept. Prim. Industr., Brisbane 3 (1978) 13; ibid. 4 (1980) 84. — *Type: S. T. Blake 13360* (BRI, holo, *n.v.;* L), Australia, Queensland, Cook Distr., Cairns, 16° 55' S, 145° 46' E, ± 1.5 m alt., 24 March 1938.

Thaumastochloa pubescens auct. non C. E. Hubb. and *Th. rariflora auct. non* C. E. Hubb.: Gardn., Fl. W. Austr. 1, 1 (1952) 309, 310, f. 91 A–E.



Map 3. *Thaumastochloa major.*

Culms up to 35 cm high. Nodes 6–10. Sheaths 1–4 cm long, (0.33–)0.5–> length of internode, pilose at least along the margins. Blades linear, flat to involute, 2–12 cm by 1.5–5.5 mm, pilose, rarely glabrous. Peduncle erect to recurved, usually gradually narrowed towards the base, where it articulates, 1.5–18 cm long, glabrous. Spikes hetero- or homomorphous: some 1.5–3 cm long, rarely with a small secondary branch at base, joints 4–10, relatively broad, 4–5.5 by 2–3.5 mm across, articulation straight to oblique, spikelets alternating in 2 very distinct rows, but still secund, others 0.35–1.6 cm long, joints 1 or 2 (or 3), relatively narrow, 3.5–10 by 1–1.5 mm across, articulation straight, spikelets ± in 1 row. Joints cylindric, glabrous. Spikelets 2.3–4 mm long. Lower glume triangular to ovate-oblong, convex to flat, rarely concave, smooth, rarely rugulose or pustulate and with some hairs, 9-nerved. Upper lemma 2-nerved. Anthers (1.1–)1.4–1.7 mm long.

Distribution. Malesia: New Guinea (Aru Islands, P. Trangan); Australia: W. Australia (Camden Sound, Cape Domett, Cockburn Ra., Elcho Isl., Giddy R., Glenelg R., Groote Eylandt, Kalumbara, Kimberley Res. St., Oobagooma, Prince Regent R. Res., NE. of Tableland St.), N. Territory (Batchelor, Borroloola, Coastal Plains Res. St., Cooinda, Kapalga Ref., Katherine Gorge Nat. P., Maranboy Pol. St., McMillan's Rd., Mudginbarry, Mummalary St., Nourlangie Safari Camp, Port Bradshaw, Twinn Falls, Wessel Isl., Yirrkala), Queensland (Ayr/Bowen Rd., Cairns, S. of Cape York, Chillagoe, Coalbrook, S. of Coen, Cooktown, Croydon, Einasleigh, Endeavour R., Glenore, Jardine R., Kennedy Rd., Mapoon Res., Normanby R., St. George R., Thursday Isl., Wrotham Park).

Ecology. Low-lying, damp, sandy places, coastal dunes, open woodland with e.g. *Allosyncarpia ternata, Aristida hygrometrica, Erythrophloeum* sp., *Eucalyptus crebra, E. dichromophloia, E. ferruginea, E. latifolia, E. miniata, E. papuana, E. polycarpa, E. tetrodonta, Melaleuca viridiflora, Perotis rara, Petalostigma banksii, Plectrachne pungens, Sorghum* sp., locally gregarious, up to 600 m alt.

Collector's notes. Solitary or tufted annual, biennial (!), or short-lived perennial (!), suberect to diffuse and spreading, bent over as if to bury the rigid tips into the soil, culms up to 45 cm high, tufts up to 45 cm in diam., rather pale to bright green to pale or reddish brown, but spikes green, spikelets paler to whitish.

Notes. Most remarkable for its heteromorphic spikes which, if not found on the same plant, would never have prompted the suggestion that one species was involved. It is no wonder that Gardner was led astray, thinking that *Holmes ex Black 5000.033* (PERTH) was a mixture of *T. pubescens* and *T. rariflora.*

Occasionally a secondary basal branch is present in the spike, but although we have seen the material from PERTH where Gardner worked, we have not seen this as well-developed as depicted by him. It is more likely that two spikes were placed one above the other; the heteromorphy is then evident.

As stated in the introduction, some spikes of *Brass 18880* (A, L) have some lower joints with 2 sessile spikelets and the stipe of a pedicelled one, reminiscent of the apparently single feature that characterises the genus *Mnesithea.* One of these spikelets may be regarded as a very short lateral branch as described above.

The confusion that results when a mixture is made in collecting this species with another is mentioned under *T. pubescens.*

4. Thaumastochloa striata Sosef & Koning, **sp. nov.** — Map 5, fig. 6a

Thaumastochloa sp.: Simon, Techn. Bull. Dept. Prim. Industr., Brisbane 3 (1978) 13.

Nodi culmi 5–8. Vaginae bene evolutae internodiis 0.5–1-plo breviores. Pedunculi 4–18 cm longi, minute puberuli (20x!) in parte tertia superiore. Internodia (1 vel) 2 vel 3. Gluma inferior longitudinaliter inter nervos 7 sulcata. Antherae 1.1–1.7 mm longae. — *Type: Lazarides & Adams 10* (L, holo; BRI, CANB, DNA, E, K, NSW, NT, US, *n.v.*), Australia, N. Territory, 25 m N.N.E. of Maranboy Pol. St., 14° 40' S, 132° 39' E, 3 March 1965.

Culms 15–25 cm high. Nodes 5–8. Sheaths 1.2–2.5 cm long, 0.5–1 times as long as the internodes, shortly soft-hairy to nearly glabrous with densely hairy margins. Blades linear, usually somewhat involute, 2–6 cm by 1.5–3.5 mm across, hairy behind the ligule and along the margins, otherwise glabrous. Peduncle erect, straight, narrowed in the lower half towards the base, where it articulates, 4–18 cm long, upper third with rows of minute hairs (20x!). Spikes homomorphous, (0.45–) 1.1–2 cm by 0.6–1.5 mm across. Joints (1 or) 2 or 3, articulation straight, glabrous. Spikelets slightly alternating, 3–4 mm long. Lower glume triangular-oblong, slightly convex, grooved between the 7 nerves. Upper lemma 2-nerved. Anthers 1.1–1.7 mm long.

Distribution. Australia: N. Territory (Maranboy Pol. St., Elcho Isl.).

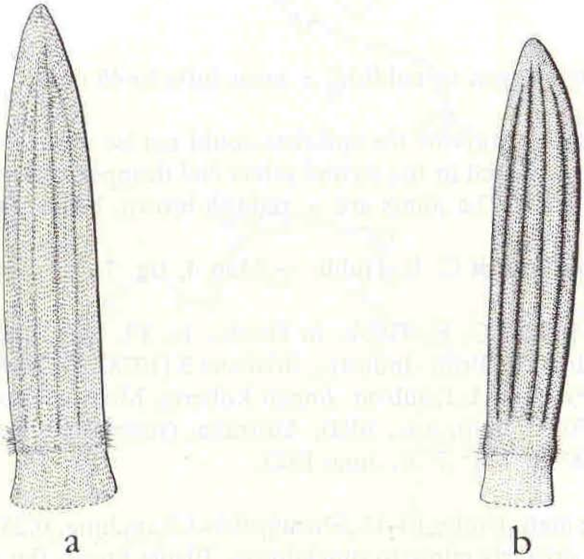


Fig. 6. Sessile spikelets of *Thaumastochloa* cont. — *a. T. striata (Lazarides & Adams 10,* type*); b. T. rubra (S.T. Blake 17636,* type*).* × 15.

Ecology. Sandy soil in open *Eucalyptus tetrodonta* forest with *Plectrachne pungens,* alt. low.

Collector's notes. Tufted, erect annual, culms spreading from base, inflorescence erect.

Note. Named for the conspicuously striate joints and lower glumes.

5. Thaumastochloa rubra Sosef & Koning, **sp. nov.** — Map 5, fig. 6b

Thaumastochloa striata similis, sed in vaginis internodiis 0.17–0.33-plo brevioribus, pedunculis 0.5–2 cm longis glabris differt. — *Type: S. T. Blake 17636* (BRI, holo; L), Australia, N. Territory, 16° 28' S, 134° 59' E, 198 m alt., 4 May 1947.

Culms up to 45 cm high. Nodes 4–6. Sheaths 0.8–1.6 cm long, 0.17–0.33 time the length of the internode, pilose. Blades linear, flat to involute, 1.5–5 cm by 1–2 mm, pilose. Peduncle ± erect, ± straight, gradually narrowed towards the base, where it articulates, 0.5–2 cm long, glabrous. Spikes homomorphous, 0.9–2.7 by ± 0.7 mm across. Joints (1 or) 2, articulation straight, 4–5 mm long, glabrous. Spikelets (see note) 3–4 mm long. Lower glume triangular-oblong, flattened to convex, 7-nerved, grooved between the nerves. Upper lemma 2-nerved. Anthers ± 1.1 mm long.

Distribution. Only known from the type.

Ecology. On flagging sandstone ridges with *Eucalyptus dichromorphloia,* 198 m alt.

Collector's notes. Green to reddish, ± erect tufts to 45 cm.

Notes. The exact position of the spikelets could not be ascertained, because all spikes were either 1-jointed or the second joints had dropped off; a unilateral position seems most likely. The joints are ± reddish-brown, hence the epithet.

6. Thaumastochloa brassii C. E. Hubb. — Map 4, fig. 7a

Thaumastochloa brassii C. E. Hubb. in Hook., Ic. Pl. 34 (1936) t. 3314, p. 3; Simon, Bull. Bot. Br. Prim. Industr., Brisbane 3 (1978) 13; ibid. 4 (1980) 84 — *Rottboellia corymbosa* L.f. subvar. *brassii* Roberty, Mon. Androp. (1960) 65. — *Type: Brass 370* (K, holo, *n.v.;* BRI), Australia, Queensland, Burke Distr., Settlement Cr., 18° S, 138° 7' E, June 1923.

Culms 7–35 cm high. Nodes 10–15. Sheaths 0.5–1.5 cm long, 0.25–1 times as long as the internodes, sparsely pilose to subglabrous. Blades linear, flat to involute, 1–3 cm by ± 3 mm, sparsely pilose to subglabrous. Peduncle slightly curved, gradually narrowed towards the base, where it articulates, 0.8–6 cm long, glabrous. Spikelets erect to erecto-patent, homomorphous, 0.3–0.8 cm by 0.8–1 mm across. Joints 1(–3), articulation straight, 3–4 mm long, glabrous. Spikelets in ± 1 row, 2–2.7 mm long. Lower glume oblong, flat, transversely rugose, 7-nerved. Upper lemma 2-nerved at base. Anthers 0.6–0.7 mm long.

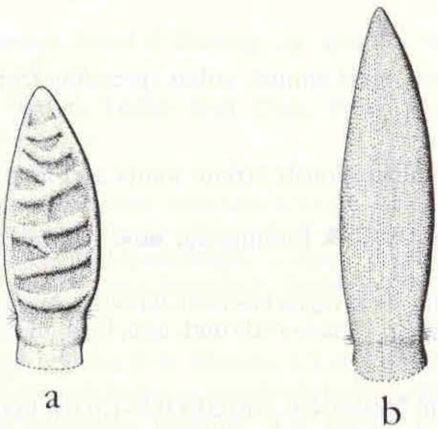
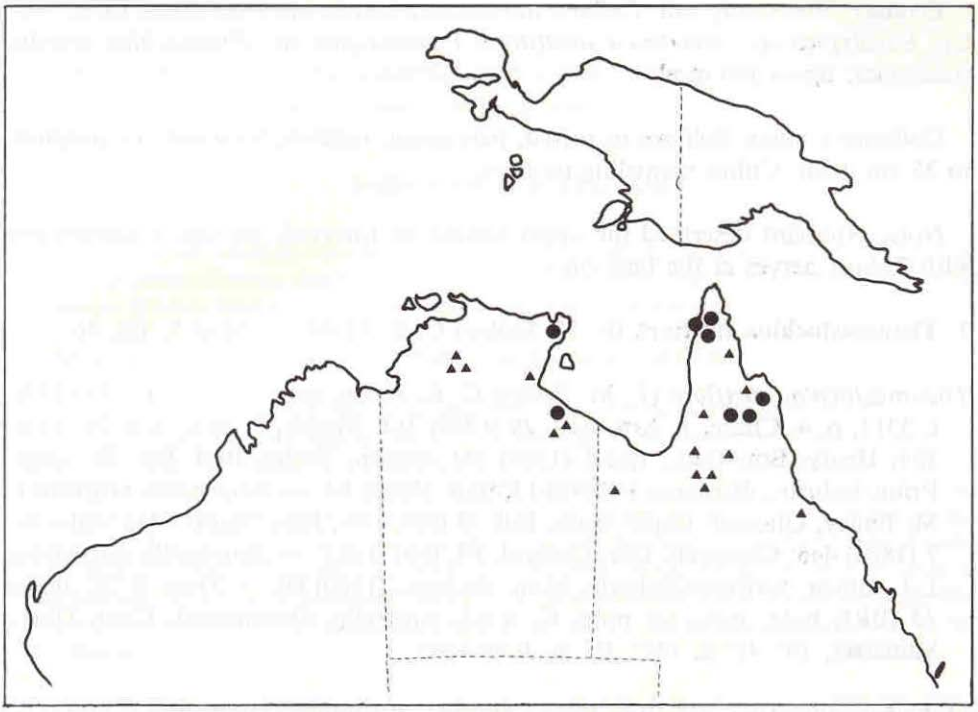
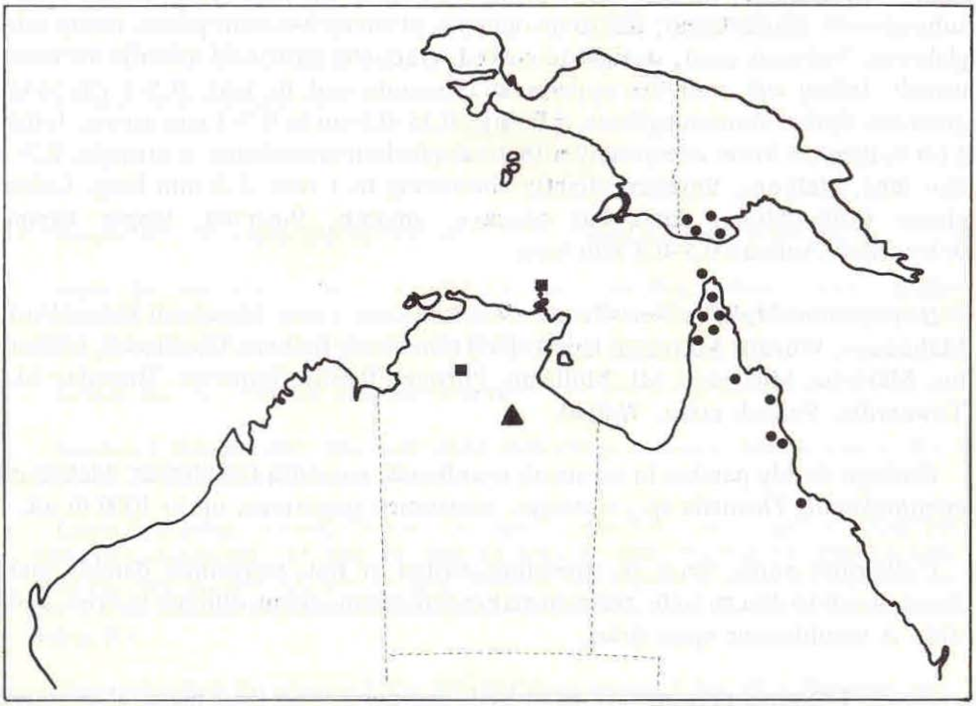


Fig. 7. Sessile spikelets of *Thaumastochloa* cont. — *a. T. brassii (Craven 4103); b. T. rariflora (Brass 18956).* × 15.

Distribution. Australia: N. Territory (Bing Bong, Cooinda, Maria Isl., McArthur R., Katherine), Queensland (N. of Chillagoe, near Croydon, Dunbar, Esmeralda, Guthalungra, Musgrave, Settlement Cr., Wenlock R.).



Map 4. Triangles: *Thaumastochloa brassii;* circles: *T. monilifera.*



Map 5. Squares: *Thaumastochloa striata;* circles: *T. rariflora;* triangle: *T. rubra.*

Ecology. Wet sandy soil, *Callitris intratropica*-heath, open savannah forest with e.g. *Eucalyptus* sp., *Melaleuca viridiflora, Petalostigma* sp., *Pheidochloa gracilis,* road-sides, up to 300 m alt.

Collector's notes. Solitary or tufted, pale green, reddish, brownish, or purplish, to 35 cm diam. Culms sprawling to erect.

Note. Hubbard described the upper lemma as 1-nerved, we saw it consistently with 2 short nerves at the base only.

7. Thaumastochloa rariflora (F. M. Bailey) C. E. Hubb. — Map 5, fig. 7b

Thaumastochloa rariflora (F. M. Bailey) C. E. Hubb. in Hook., Ic. Pl. 34 (1936) t. 3313, p. 4; Chase, J. Arn. Arb. 20 (1939) 314; Reeder, J. Arn. Arb. 29 (1948) 355; Henty, Bot. Bull., Lae 1 (1969) 181; Simon, Techn. Bull. Bot. Br. Dept. Prim. Industr., Brisbane 3 (1978) 13; ibid. (1980) 84. — *Rottboellia rariflora* F. M. Bailey, Queensl. Dept. Agric. Bull. 8 (1893) 86; Rept. Austr. Ass. Adv. Sc. 7 (1898) 446; Compreh. Cat. Queensl. Pl. (1912) 617. — *Rottboellia corymbosa* L.f. subvar. *rariflora* Roberty, Mon. Androp. (1960) 66. — *Type: F. M. Bailey 15* (BRI, holo, *n.v.,* see note, K, *n.v.*), Australia, Queensland, Cook Distr., Somerset, 10° 45' S, 142° 35' E, June 1897.

Ophiuros pubescens auct. non Dom.: Hitchc., Brittonia 2 (1936) 128.

Culms 10–60 cm high. Nodes (4–)8–12. Sheaths 0.8–2.2 cm long, 0.17–0.33(–more than 1 in apparently juvenile plants) times as long as the internodes, pilose, rarely subglabrous. Blades linear, flat to involute, 2–10 cm by 2–4 mm, pilose, rarely subglabrous. Peduncle erect, straight to curved, gradually narrowed towards the base, usually falling off with the uppermost internode and its leaf, 0.5–3 cm long, glabrous. Spikes homomorphous, cylindric, 0.35–0.9 cm by 0.7–1 mm across. Joints 1 (or 2, then the lower one usually without a spikelet), articulation ± straight, 2.5–3 mm long, glabrous. Spikelets slightly alternating in 1 row, 2–3 mm long. Lower glume ovate-oblong, somewhat concave, smooth, 9-nerved. Upper lemma 0–3-nerved. Anthers 0.5–0.8 mm long.

Distribution. Malesia: New Guinea (Western Distr.: near Morehead Patrol Post, Mabaduan, Wuroi); Australia: Queensland (Andoom, Batavia, Cooktown, Lockerbie, Mareeba, Musgrave, Mt. Mulligan, Portland Roads, Somerset, Thursday Isl., Townsville, Vallack point, Weipa).

Ecology. Sandy patches in savannah woodlands, e.g. with *Eucalyptus, Melaleuca cunninghamii, Themeda* sp., clearings, sometimes gregarious, up to 1000 m alt.

Collector's notes. Erect to spreading, tufted or not, sometimes densely mat-forming, up to 30 cm high, green to rather dull green, culms oblique to erect, reddish. A troublesome spear-grass.

Notes. The type, presumed to be in BRI, was not among their material although all was sent. The specimen in K cited by Hubbard was not lent to the authors; it may be the holotype.

Brass 18554 (A, L) has glabrous blades and pedicelled spikelets reduced to a minute scale, otherwise it seems to belong here.

INDEX OF COLLECTORS

Only numbered collections have been included. The 'H-' and 'T-' -numbers refer to the sequence of the taxa as employed above. Specimens cited in literature but not seen have been included with their identifications *between brackets* when these seemed acceptable, otherwise they have been deleted.

124: (H4a), Milne-Redhead & Taylor 9058: H1, Morain 307: T1, Morton 601: T7, 1707: T3, Murata et al. T-16580: H4a, 16988: H4a.

NGF 38699 (Henty & Katik): T1, 49393 (Henty & Forman): T7, 49686 (Henty & Carr): T1.

Odashima 129: (H4a), 562: H4a, Oersipuny 18: H4a.

Perry 1974: T1?, Pedley 2637: T3, 2648: T6, 2716: T3, 2745: T2, Peterham 389: T3, Pollock 32: T1, Pullen 7088: T7, 7173: T7.

Quarré 137: H1.

Rust 33: (T1).

Salesiēns 832: H1, Santos 4055: H4a, 4986: H4a, Schmitz 1009: H1, Schrooten 1091: H1 (wrong label), Scribner 3: (H4a), Shantz 543: (H1), Shimada 4852: (H4a), Simon & Williamson 1872: H1, L. S. Smith 04364: T1, Specht 93: T3, 190: T3, 683: T3, 731: T3, Squires 165: H4a, Staples 010572/12: T1, Suzuki 20066: H4a, Symoens 3341: H1, 8267: H1, 12237: H1, 12285: H1, Symon 4785: T2, 4845: T3, 4883: T1x3, 4926: T6, 5022: T1, 7761: T3.

Thwaites CP 867: H3, Trapnell 1522: H1, 1706: (H1).

Vanoverbergh 2802: H4a, Vesey-Fitzgerald 1628: H1, 2975: H1.

Wang 12768: H4a, C. T. White 8674: T1, Wiehe N. 182: (H1).

Yamamoto et al. 11: H4a, Yamamoto & Suzuki 579: H4a.

Zerny 479: H1.